SIXTEENTH ANNUAL REPORT OF THE DIRECTOR OF THE BUREAU OF SCIENCE

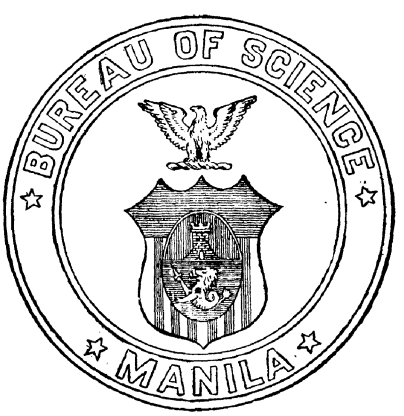
PHILIPPINE ISLANDS

TO THE HONORABLE
THE SECRETARY OF AGRICULTURE AND
NATURAL RESOURCES

BY

ALVIN J. COX
DIRECTOR OF THE BUREAU OF SCIENCE

FOR THE YEAR ENDING
DECEMBER 31, 1917



MANILA
BUREAU OF PRINTING
1918

SIXTEENTH ANNUAL REPORT OF THE DIRECTOR OF THE BUREAU OF SCIENCE

THE GOVERNMENT OF THE PHILIPPINE ISLANDS,
DEPARTMENT OF AGRICULTURE AND NATURAL RESOURCES,
BUREAU OF SCIENCE,

Manila, January 1, 1918.

SIR: I have the honor to submit the following general account of the Bureau of Science and the work performed therein from January 1, 1917, to December 31, 1917, which completes the first year's work in the newly organized Department of Agriculture and Natural Resources.

The demands upon the Bureau of Science have increased during this year as they have during each preceding year. As in previous years the Director and his staff have answered many inquiries and have endeavored to satisfy the demand for information on a great variety of subjects from manufacturers, professional men, and laymen. This demand has been greater than in preceding years on account of the stimulus given economic and industrial development by the Government, of the more friendly attitude of the Filipinos toward capital coming to the Philippine Islands, and of the demand for raw materials stimulated by the war. Inquiries have been answered with regard to new tanning materials; nut oils; natural gums; adhesive materials; tree floss; methods of preserving, drying, or otherwise utilizing food products; the nutritive value of Philippine vegetables; the preparation of papaya gum; Philippine birds and fishes; dye stuffs; medicinal plants; roselle; iron ore; petroleum; gold; coal; asphalt; copra; materials suitable for the manufacture of paper and paper pulp; a Philippine substitute for cork; the production of silk; the use of coconut husks and shells; maguey fiber; pineapple fiber; pearl, pearl shell, and sponge fisheries; rubber; starch; *Datura alba;* fungus and other diseases of plants; fire wood; termite (anay) exterminator; the manufacture of ink; coconut butter; banana flour; salt; sugar; alcohol; the manufacture of bricks, roofing tiles, and other fire-

proof roofing materials; and other products and industries. In order to show the increase of routine work performed, attention is called to the following statistics with regard to the Bureau of Science:

	Fiscal year.			
	1906-7	1909-10	1912-13	1916
Chemical and physical analyses and tests of metals, minerals, clays, cements, fertilizers, soils, fuels, waters, paper, gums and resins, foods, drugs, etc.	3,064	9,353	15,602	19,823
Examinations of fæces, urines, blood, sputum, gonococci, rabies, and rats for plague, and miscellaneous bacteriological examinations	26,449	34,913	152,471	365,645
Total analyses, tests, and examinations	29,513	44,266	168,073	385,468
Available appropriation	₱381,838.28	₱404,159.16	₱409,884.30	₱371,976.00

NOTE.—The manufacture and sale of vaccine virus, serums, bacterial vaccines, prophylactics, etc., have grown even more rapidly than the analyses, tests, and examinations listed above.

During the last few years the Bureau of Science has had no increase in appropriation; in fact, there has been a decided decrease in available appropriation. With such a large increase in the amount of routine duties, many of our employees are much overworked, and there has been time for little other than routine toil. There has not been enough time to give to inquirers all of the consideration that they might have received; and much valuable economic research, except that with an immediate technical application, has had to be left entirely undone. More time should be available for investigative work.

New building.—The new building to contain the operating and bleeding room for serum animals and two small laboratories for use in connection therewith was completed and occupied during the year. The floor, walls, ceiling, and roof are entirely constructed of reënforced concrete, so that they may be easily and thoroughly washed with disinfectants. The completion of this structure is very timely, for the demands for serum and vaccines made from large animals, such as smallpox vaccine and antitoxin, normal horse, and antitetanic serum, have greatly increased. Seventeen horses are now undergoing immunization. The serum and vaccine work is greatly facilitated by this new building, but the necessity is already felt for the construction

of an addition to the new building, thus enabling all the work to be done under one roof.

During the next year the erection of a concrete serum laboratory as an extension of the operating and bleeding room and in connection therewith a serviceable economic cold-storage room is recommended. The cold storage in use at present not only taxes the machinery to its full capacity, due to the antiquated system and faulty construction, but is unsatisfactory for other reasons. For several years it has required almost yearly repairs at a considerable cost. The Philippine Government desires that its serum laboratory compare favorably with any foreign laboratory; with these changes we would have an institution of which any modern and progressive country would be rightly proud.

A small wooden laboratory is very much needed for the preparation and keeping of tetanus cultures, tetanus toxin, and plague cultures. Such an arrangement will safeguard any possible contamination of biological products by tetanus or plague germs and prevent any catastrophy that might result from such an accident. The present inadequate quarters of the taxidermist, if equipped with gas, electricity, and vacuum, would be perfectly serviceable, as it is directly adjacent to the plague house. The taxidermic workroom should be removed to more adequate new quarters.

Aquarium.—Several new collections of fishes have been added to the exhibits. The twenty-seven exhibition tanks are always well filled with a complete display of bright-colored fishes, sea anemones, crabs, sea urchins, starfishes, etc., and such sea animals as are found in the tropical waters of the Philippine Islands. The exhibits have been kept up to the usual standard, and the number of species and specimens is slightly larger than reported at the close of last year. The aquarium has received much favorable comment from visitors from many parts of the world. It is believed that no other aquarium has a display of more varieties of brightly colored fishes. The aquarium of the Bureau of Science has been so successful that I have received letters requesting information that might be of assistance in establishing aquaria in San Francisco and in Singapore.

The provision that I have kept in effect that school children may be admitted to the aquarium in groups with their teachers has been much appreciated and has been taken advantage of by the public schools, by the Government orphanage, and by many regularly established private schools. There have been

22,020 paid admissions and over 4,000 free admissions to school children during the year. In January the Monday Musical Club used the grounds of the aquarium for a concert, for which it paid the Bureau of Science the regular admission price for each person attending.

Monkeys.—Under date of January 16, 1917, the Rockefeller Institute for Medical Research, New York, acknowledged the receipt of the monkeys that were collected and shipped to them by the Bureau of Science. Thirty-seven monkeys were received in New York, two of which died shortly after arrival, leaving thirty-five out of the original shipment of ninety-nine from Manila.

COÖPERATION AND PUBLICITY

The Bureau of Science has been able greatly to assist many branches of the Government, commercial houses, and private individuals. It has also been able to be of considerable service in assisting Philippine purchasers to connect with satisfactory dealers in, or manufactures of, raw products, dyes, bleaches, and other chemicals. The conditions induced by the war seriously interfered with many industries, until those responsible for them were able to establish new trade relations to take the place of those interrupted by the war.

The information in the Bureau of Science that will benefit or improve agriculture, health, mining, and industrial, commercial, and other economic conditions has been more and more used. Many inquiries can be now answered by the Bureau of Science by sending copies of industrial press bulletins—of which we have now issued nearly a hundred—of industrial resources of the Philippine Islands folder, Philippine Bureau of Science charts, or by reference to the Philippine Journal of Science or other sales publications. The completion during the year of the contents and index to Volumes I to X of the Philippine Journal of Science also facilitates this work.

While the information circulated by directions and other written documents has been readily received, there are many people who should be aided who cannot be assisted in this way. It is gratifying that so many people have come to the Bureau of Science actually to see the work performed and the results accomplished and to get first-hand assistance in the work that they are doing. However, the need of employees to demonstrate by word of mouth, to supplement written directions, the improved methods of procedure along the lines of economic and industrial development, in order to bring about needed reforms and develop

ment, is continually more evident. Where work of this kind has been done, the appreciation of it has been keen, and the improvement that it has developed has been great. There is immediate need for a number of statisticians and demonstrators to explain to, and place before, the public the collected data and results of experiments, to demonstrate new and improved methods, and to introduce new industries.

Coöperation with scientific institutions throughout the world has been continued as heretofore. Laboratory space and equipment have been granted to Mr. H. A. Lee, plant pathologist of the United States Department of Agriculture, who was sent to the Philippines to study the methods of controlling the serious disease of citrus fruits, known as citrus blight, caused by a specific bacterium, which having recently been introduced into the United States is attaining considerable proportions in certain orange-growing districts. Visiting mining engineers with the object of investigating Philippine mineral resources have availed themselves of the Bureau of Science mineral collection. It has always been the policy of the Bureau of Science in so far as possible to furnish accommodations to trained scientific men desiring to carry on research work, and every facility at the disposal of this institution in such cases is made available.

Individuals from various parts of the world have written to the Bureau of Science for help and are more than willing to pay or to render assistance in return when it is needed. For example, a professor in Zürich, Switzerland, requested that we send him samples of sea water from the southern China Sea that were needed in his investigations.

THE NATIONAL RESEARCH COUNCIL

Through the office of His Excellency the Governor-General, the Bureau of Science has offered its assistance to the National Research Council, Washington, D. C.

PHILIPPINE FOOD COMMISSION

The Philippine Food Commission with the Honorable the Secretary of Agriculture and Natural Resources as chairman, and the Directors of the Bureaus of Science, Agriculture, Supply, Health, and Education as members, held regular weekly meetings from the time of its appointment by Executive Order No. 50, June 8, 1917, until the passage of a law regularly providing and appropriating for a food campaign. The food-campaign work was carefully outlined in many of its details, and plans were laid for, and active work begun on, an effective food-production cam-

paign, especially immediately to stimulate an increase in staple-crop production in those provinces having railroad or other shipping facilities, to the end that the surplus produced over and above the actual needs of the provinces themselves can be quickly moved and transferred to other provinces where deficiencies may exist. On July 30 various committees were named and the work was divided in order that the food-production campaign should be carried on most effectively. The Director of the Bureau of Science was appointed chairman of the Committee on Publicity.

The Committee on Publicity has received the most earnest support of all the newspapers and church organizations of the Archipelago, and all of the information that it was possible to prepare and send out was printed and circulated. The opinion of the Food Commission was that the greatest and most important service required of our agriculture under existing conditions was an enlarged production of staple food crops and other crops for local consumption. The Committee on Publicity has done what it could to increase the production of foodstuffs by enlarging the area devoted to their cultivation in the regions where they are habitually grown. We have issued 30,000 copies of a "Food Campaign" poster, which has been effectively distributed throughout the provinces, municipalities, barrios, townships, settlements, rancherias, and schools of the Philippine Islands. In accordance with the letter of the chairman the copies have been posted in the municipal markets, in the churches, in the most popular social resorts, in drug stores, in business houses, and in the municipal buildings, besides being distributed by municipal agricultural societies and municipal food committees. In addition to the poster on planting it is intended as soon as possible to issue a second poster on general thrift and to urge the strictest economy in husbanding crops after they have been produced.

Owing to the scarcity of work animals it was believed that much greater results might be attained by the careful selection of seeds, which heretofore has been much neglected, than in any other way. Without increasing the cultivated area an iota, the proper selection of rice or corn seed at harvest time in the Philippine Islands under normal conditions will result in a 20 per cent increase in the crop during the first and an additional 10 per cent during the second year. Accordingly the Committee on Publicity has prepared and issued 100,000 copies of a leaflet, entitled Selection of Seed Palay, which has been circulated in the Ilocano, Tagalo, Pampango, Bicol, Samar, Cebu, and Panay dialects and in English. A small leaflet for smaller circulation on the Selection of Corn for Seed is being prepared.

A large number of other short articles concerning questions of variation and fertilization of crops, gardening, elimination of waste and spoilage of edible food, the encouragement of poultry raising, the maintenance and increase of breeding animals, the stimulation of home canning and drying, and of increased production and conservation of food generally and food-campaign slogans and food charts have been circulated. Many sermons on the food situation have been preached by the parochial clergy, and the leaflets on seed selection have been read from the pulpit.

BUREAU OF SCIENCE GARDEN

In accordance with the suggestion of the Philippine Food Commission that each member would undertake the cultivation of a vacant lot if suitable land could be found near enough to his office to enable him to use the Government force out of official hours, the Bureau of Science has secured authority from the city of Manila for the use of about 3,500 square meters of its vacant property at the corner of Calle San Andrés and Taft Avenue. The land has been thoroughly plowed and has been fenced and is almost in condition for planting. Practically every employee in the Bureau from the highest to the lowest paid has agreed to participate after office hours. The tentative rules governing the operation of the garden are as follows:

1. The garden shall be under the general supervision of a superintendent to be designated by the Director of the Bureau of Science.
2. Each participant shall be an employee of the Bureau of Science.
3. Those participating in the garden shall be required to plant and cultivate at least one plot of 1.5 by 9 meters.
4. Each participant shall work at least twice a week at such time after office hours as the superintendent shall designate, but must come oftener whenever it is considered necessary.
5. The products of the plot shall belong to the individual working it, except that no sale of produce shall be made except through the channel authorized by the superintendent. Produce for home consumption may be removed at any time with the authority of the superintendent. Sale of products can be arranged through the superintendent, who will see that a reasonable price is secured. The net proceeds of sales will be apportioned according to the produce turned in.
6. Neglect of plot assigned, failure to attend regularly without good reason, or a violation of any regulation shall be considered sufficient cause to deprive an employee of the rights and privileges of participating in the garden.

FISHERIES

Philippine fisheries should not only be improved, but they should be developed into a great industry. The greatly increased cost of imported foods and meats makes it imperative that these

resources be exploited to a greater degree than ever before for the purpose of increasing the food supply. In most countries the fisheries' survey precedes the development of this industry, and in the Philippine Islands great development along these lines can be scarcely expected until this work has been done. On the other hand, there is very active interest from a number of sources in the Philippine fishery resources, and there is every reason to anticipate rapid growth if the Government can afford to do the pioneer work. As in many other tropical countries fish constitutes a very large part of the daily food of the people. Rice and corn are the most important food crops of the Philippine Islands. Of almost equal importance as food are the many kinds of fish, inhabiting both fresh and salt water; and the importance of the industry can be hardly overlooked. Fishing is only second to agriculture among the industries of the Archipelago, both as to the value of the product and the number of individuals engaged in, and benefited by, it.

The work that the Bureau of Science has already been able to do and that is contained in its publications on economic marine products has been very much appreciated. However, a thorough and comprehensive study of the habits, breeding places, rates of growth, distribution, migrations, etc., of the marine animals of commercial importance of the Philippine Islands and to discover new resources of marine wealth in the Islands should be undertaken. Detailed information of the trepang (holothurian) industry with the view of spreading it to various northern islands should be secured. At present the catch is confined almost wholly to the Sulu Islands. There is a considerable number of species of trepang about Mindoro and various other islands that are not being exploited at the present time because the fishermen are in ignorance of their value. The collection of sponges in Philippine waters is comparatively a new industry. The elephant's-ear sponge collected in the Philippine Islands is of great value. The Bureau of Science has assisted this enterprise as much as possible, and it should be encouraged. The sponge industry has been and should be further extended by publicity given it through the Bureau of Science. Due to the scarcity of turban and top shells in the market, certain of the Manila button factories have been forced to close during a part of the year. It is believed that there are many beds of these shells untouched that might be easily exploited. Data regarding the occurrence of these are of great value, and it is believed that

much information of this sort might be obtained if sufficient personnel were available. The method of taking salt-water fishes for the market is with nets and seines. These are often of such fine mesh that no fish can pass them. Many of the fry of food fishes are thus sacrificed, because the fishermen have not been instructed with regard to the conservation of the industry. During the typhoon months all corrals are removed from the salt water and are stored until the next season of smooth water. Stormy weather is always reflected in the condition of the fish markets. If deep-sea fishing with steam trawlers were established, only the roughest weather could reduce the available supply of food fishes.

The supply of fish can be also greatly increased by planting fish in lakes and streams that do not now produce them. This method is well known and extensively practiced in other countries and is recognized as a government function. The Bureau of Science has planted carp in Mindanao and black bass in Laguna de Bay, in lakes near San Pablo and Baguio, and in Lanao Lake and has accomplished as much as possible with the personnel available. There are many other lakes where food fishes could be planted and so produce an increase in food supply. The growing of bañgos in ponds, now practiced only in the vicinity of Manila, should be extended to as many large towns as possible. It may be possible to take up this feature as municipal industries. The methods of cultivation should be studied with a view of improving them. It may be possible to cultivate other and better species of fish, and experimentation of this kind should be undertaken or extended by the Bureau of Science. Improved methods of drying, salting, etc., are important to preserve the excess of fish, shrimps, and other sea foods when these are abundant, so that there shall be no shortage.

An item to cover the expense of this work was included in my appropriation estimate for the fiscal year 1918, but was not allowed by the Legislature. The Japanese Government has seen fit to request permission to send a boat to Philippine waters in the interest of its Japanese fishermen; and a boat is now here to do work similar to that requested. It seems to me that our own Government should be more than willing to do the work in its own waters for its own fishermen that a foreign Government can do here for her subjects. The importance of this work can be hardly overestimated, and it is especially recommended for the action of the Legislature for the fiscal year 1919.

A PRACTICAL APPLICATION OF SCIENCE

Under date of May 19, 1917, I wrote to the City Engineer as follows:

You called my attention this morning to the expense entailed upon the City in removing the green algae every day from the breakwater along the bulwarks in the vicinity of the Army and Navy and Elks Clubs. It has occurred to me that the accumulated material could be sprayed with a solution of copper sulphate so that the disagreeable odor of hydrogen sulphide could be eliminated and then the material removed only when the quantity becomes troublesome. Copper sulphate will decompose the hydrogen sulphide as it is formed by precipitating the sulphur as copper sulphide. It is probable that the action of the copper sulphate might also be to reduce the bacterial action that forms hydrogen sulphide. One part of copper sulphate in one million parts of water is recommended for destroying *Cladophora* which is the form of algae in question. The only thing to be taken into consideration is to use a copper sulphate solution sufficiently weak so that it will not at the same time kill marine animals. The Bureau of Fisheries in Washington has worked out that black bass are not injured when 2 parts of copper sulphate are present in 1,000,000 parts of water. On this basis copper sulphate could be sprayed in considerably stronger solutions onto the débris taking precautions such that when finding its way into the sea water below that the strength of the solution formed did not greatly exceed 2 parts per million. I think you will find this suggestion very much worth trying. I am,

and under date of June 8, 1917, he replied:

The DIRECTOR, BUREAU OF SCIENCE,
Manila, P. I.

SIR: You will no doubt be interested to know that by following your instructions for the use of copper sulphate this Department was enabled to entirely eliminate the nauseous odor arising from a deposit of putrid algae recently existing on the Bay front near the Elks Club. The undersigned, therefore, takes this opportunity to thank you for your valuable advice and kind assistance in eliminating this nuisance.

STANDARDIZATION OF GOVERNMENT MOTOR TRANSPORTATION

On January 3, 1916, His Excellency the Governor-General issued Executive Order No. 1, appointing "The Government Motor Transportation Committee" composed of the Directors of the Bureaus of Public Works, Supply, and Science. The duties of the committee are to "pass upon all purchases of automobiles or other motor vehicles by the Government, with a view to standardizing the quality thereof." The committee has been very active in its study of the various transportation problems presented in the Philippine Islands. In its deliberations the committee has consulted the experience of former committees and has sought information from all reliable sources, not only here but abroad as well. As a result of its studies the committee has

adopted as standard what is thought to be the most satisfactory passenger car for the Philippine Islands: namely, the Ford automobile. For motor trucks of more than one-ton capacity the committee has restricted all purchases to the White, and for less than one ton to the Ford. The question of the most desirable motorcycles also has been studied. The Harley-Davidson has been adopted as a general purpose machine, and as a lightweight motorcycle the Indian. The general specifications for both of these motorcycles are given in the committee's standardization leaflet 6.

The committee is open to conviction, is collecting new data and information as they are available, and is always ready to alter its findings upon the submission of conclusive evidence that improvement is possible. It is of interest to know that the conclusions of The Government Motor Transportation Committee are sustained by other large users of motor transportation.

STANDARDIZATION OF SUPPLIES

The permanent committee known as the "Committee on Standardization of Supplies," appointed on March 28, 1916, by His Excellency the Governor-General, and composed of the Directors of the Bureaus of Supply, Public Works, and Science, has been very active. The duty of the committee, as defined in Section 2050 of the Administrative Code of the Philippine Islands for 1917, is: "After studying the requirements of the various branches of the service, to establish certain makes, grades, qualities, or kinds of material and equipment as the standards of their class to be furnished for Government use, and said committee shall also direct the use and redistribution of serviceable material and equipment belonging to the various branches of the service, whenever in its opinion the same can be used more advantageously elsewhere, * * *."

Before any item was standardized, the committee studied the merits and demerits of numerous competing items and sifted the essential information submitted by interested parties, users as well as sellers of articles, in order that its findings be not arbitrary but meet the real need of Government consumers. The intended use of each article, its source of supply, the manufacturing process involved, the control of specimens delivered, the method of sampling and analyzing, the segregation of descriptive matter, etc., were carefully considered. Specifications for Portland cement; automobiles; draft, deep-well, and pitcher pumps; galvanized iron; adding machines; motorcycles; and carbon paper have been already adopted and published.

The task before the Committee on Standardization of Supplies is still large, and several more classes of material are now being actively studied. Stationery represents one of the larger expenditures, and the committee believes that a considerable saving can be effected in the various items of paper. The committee, in conjunction with the Director of Printing and other officials of the Government, now has under consideration the "Paper" question, and for convenience of study has established the group headings of correspondence, envelopes, memorandum pads, Bureau of Justice and the Courts, and statistical and rough-draft work. The data are almost ready for final examination.

A method for assembling and disposing of dormant and serviceable stock in the various government offices has been studied, and a plan has been put into operation that will redistribute this property to where it is needed or will effect its sale.

The work on the standardization of supplies has aroused real interest among many officials of the Government, who now exercise more care in placing requisitions and in avoiding waste. It is believed that the ultimate result of the work of the Committee on Standardization will be better service for all branches of the Government, lower prices, a reduction of the stock necessary to be carried, practically the elimination of dormant stock, and a saving in clerical work for all branches of the service. A comprehensive report of the work of the Standardization Committee has been submitted to His Excellency the Governor-General.

CALAMBA ESTATE IRRIGATION COMMITTEE

A committee composed of the Directors of the Bureaus of Public Works, Science, and Agriculture for the purpose of determining the area of land entitled to irrigation and of investigating and determining the quantity of water required properly to irrigate that portion of the Calamba Estate entitled to irrigation under its classifications as "irrigated land" was appointed on December 7, 1916, by the Acting Secretary of the Interior. The committee has completed the necessary studies, tests, and investigations, and at the middle of the year made a report of the results thereof, together with its recommendations.

GEOGRAPHICAL NAMES

On June 23, 1917, His Excellency the Governor-General issued Executive Order No. 53, reorganizing "The Philippine Committee on Geographical Names," constituted by Executive Order No. 95, series 1903, to consist of the Secretary of the Interior, chairman, and the Director of Coast Surveys, the Chief

of the Executive Bureau, the Director of Education, the Director of Lands, the Director of the Bureau of Science, and the Director of Posts, members. The functions of the committee are to "discharge the same duty in respect to Philippine names as has heretofore been discharged by the Board of Geographical Names appointed by President Harrison in 1890." The committee has been very active and has held regular meetings on the first Wednesday of each month. An executive committee consisting of the Directors of the Bureaus of Coast Surveys, Science, and Posts considers the spelling of geographical names submitted for action and reports its recommendations to the Philipipne Committee on Geographical Names. During the year 1917 decisions with regard to 367 geographical names were made.

INDUSTRIAL MOVING PICTURES

The Director of the Bureau of Science served with a committee of the Manila Merchants' Association to assist in arrangements for the moving pictures depicting the scenic attractions and industries of the Philippine Islands that are to be given to the public of the United States and other countries by the Burton Holmes Syndicate. In order to assist in this work and to enable the cinematographer to secure pictures that will be attractive and at the same time awaken an interest in the Philippine Islands among the people of other countries, I submitted the following list of subjects:

1. *Sugar.*—Cane planting, cultivating, irrigating, cutting, transporting to mill; native carabao mill; native evaporating plant; modern mill; sacking, shipping, etc.

2. *Nipa and nipa alcohol.*—Nipa swamps, traveling in swamps, gathering tuba, transporting tuba in banca, distillery and distilling process, transporting alcohol.

3. *Hemp.*—Planting, cultivating, irrigating, cutting, stripping, drying, pressing and baling, hauling and placing aboard steamers, receiving in Manila, rebaling, classifying, shipping from Manila, etc.

4. *Tobacco.*—Planting, cultivating, gathering, curing, baling, transporting; factory; individual cigarette machines; hand cigarette making.

5. *Rice.*—Plowing, planting, transplanting, irrigating, harvesting, transporting to graneries and threshing, husking, winnowing, cooking, etc.

6. *Coconuts.*—Sprouting, planting, cultivating; grove; gathering nuts, transporting in small boats and rafts, shelling and opening nuts, drying copra, sacking, shipping; native oil press; modern oil mill; vino manufacture, etc.; coconut-husk mattress and bristle-fiber industry.

7. *Pineapples.*—Growing and canning.

8. *Coffee.*—Planting, cultivating, gathering, growing, transporting to market.

9. *Food products.*—Chocolate, macaroni, bamboo as food. (A scene of natives digging and preparing bamboo shoots for food, etc.)

10. *Fruit industry.*—Gathering bananas; growing and picking mangoes, papayas, etc.

11. *Mining.*—Gold, iron, limestone, road metal, guano caves, etc.

12. *Pottery.*—Gathering and preparing clay; shaping, burning, decorating, transporting, and selling the vessels.

13. *Salt.*—Manufacture from salt springs and sea water by evaporation in the sun and by fire; packing, transporting, selling, etc.

14. *Hats.*—Gathering buntal, bamboo, sabutan, and other fibers; preparation for weaving, weaving, shipping, selling, bleaching, blocking, and whitening at Lucban, Baliuag, Calasiaw, Morong, Pototan, etc.

15. *Match factory.*—The complete process of making matches from cutting the log of wood to packing the filled boxes.

16. *Weaving.*—Cotton growing, preparation of threads, setting up the loom, weaving, preparing abacá and piña fibers, polishing cloth.

17. *Embroidery and lace making.*—In schools, in homes, in Bilibid, selling.

18. *Fishing.*—With hook and line and from boats with nets; throwing and hauling hand nets, large nets; drying small fish, salting, shipping. This backward industry should equal in commercial importance the same business in Japan.

19. *Hunting.*—With nets, with dogs, with spears, with bows and arrows, with traps.

20. *Boat manufacture.*—Making bancas, cascos, vintas, etc., including loading and life aboard. This might include canoe building, cutting timber in the forests, shipping timbers, boat production, local slipways. Boats with double and triple banks of oars at Aparri and Abalug.

21. *House building.*—Cutting and transporting bamboo; cutting nipa; making nipa shingles (pauid); erecting, covering roof, and walls of nipa house; moving nipa house by man power; tree house, Moro house over water, etc.

22. *Rattan industry.*—In forests, cutting, transporting, preparation of strips, making bales, bed building, making chairs, tables, desks of rattan and bamboo, etc.

23. *Stone work.*—Quarrying, transporting, working, manufacturing candlesticks, rice mortars, corn mill, chocolate grinders, paving stone, etc.

24. *Gold- and silversmith.*—These may be shown at work making caneheads, rings, neck chains, etc.

25. *Wood carving.*—Hand carving of images, tables, chairs, wardrobes, canes, etc.

26. *Chinelerias.*—The making of slippers and wooden shoes.

27. *Vegetable-oil industry and soap making.*—Views outside and inside of both primitive and modern factories.

28. *Transportation.*—Carromatas, carabao carts, bull carts with and without covers, bancas, sail boats, etc., of the various provincial types.

29. *City and provincial scenes.*—Street scenes in Manila, private schools out for exercises, Pagsanjan Falls, etc.

CARNIVAL EXHIBIT

As in former Carnival Expositions the Bureau of Science actively participated in that for 1917. While many of the lines of work of the Bureau of Science do not lend themselves to exhibition purposes, it is believed that no exhibit was better

received. The Bureau of Science display was of special interest to both laymen and to persons who possess scientific or technical education and was very useful in directing the attention of the public to the extensive natural resources and industrial possibilities of the Philippine Islands.

One feature of the exhibit showed mining possibilities of the Philippine Islands. It included an interesting collection of gold, copper, iron, coal, petroleum, asphalt, and other ores and specimens. The labels taken collectively fairly displayed the distribution of these substances. A very large relief map of the Philippine Islands made in the Bureau of Science, showing the principal mineral localities and geology of the Archipelago, attracted considerable attention.

The industrial and commercial display consisted of samples of palm sugar, essential oils, alcohol, Philippine palm brandies, coconut products, including samples of copra dried by the Bureau of Science process, vegetable oils, terpenes, paper-pulp materials, leather tanned by the Bureau of Science, tanning materials, tanbark grinders, lime and lime products, raw materials for Portland cement, etc. Specimens of marine products such as sponges, pearls, pearl-shell, fish, etc., were also exhibited. All of these samples were accompanied by charts giving statistical data and illustrating the value of such products.

A set of seventeen framed charts dealing with industrial possibilities and certain natural resources of the Philippine Islands concerning agriculture, mining, marine and industrial products, etc., was displayed. The Philippine Journal of Science and other publications of the Bureau of Science were exhibited, and industrial and publications folders were distributed to those interested.

Samples of serums and vaccines manufactured by the Bureau of Science were exhibited. These products were very interesting to medical practitioners and received a great deal of attention from them. A working exhibit demonstrating the methods of preserving and mounting botanical specimens was also shown.

Under date of February 15, 1917, the Director General of the Philippine Carnival Association wrote: "I wish to express to you on behalf of the Association and personally my appreciation for the participation of your Bureau in the Industrial Exhibit at the Carnival of 1917. The personal interests manifested by you and your assistants in the Exhibit made it a real interest and value to the thousands of visitors, and proved a substantial contribution to the success of the carnival. It is desired to make special mention of the arrangement and decoration of the booth,

the working exhibit showing the grinding of tan bark, and mining, features which were generally and favorably commented upon * * *."

The Bureau of Science has been requested to participate in the Government Exhibit at the Philippine Carnival in 1918, and an industrial exhibit is now being prepared for that purpose.

FIRST ANNUAL FAIR OF THE CENTRAL LUZON AGRICULTURAL SCHOOL

The Bureau of Science exhibition at the Central Luzon Agricultural Fair was mostly of an educational nature. A display of minerals of different kinds; photographs indicating the different phases of mining, agricultural, and industrial activities of the Philippine Islands; and samples of different industrial products were shown. A demonstration of the different manipulations in tanning hides was carried on in order to show the great possibility of tanning small hides and to encourage the people to do this at home. Publications of the Bureau of Science for the purpose, relating to the subjects of agricultural industries and foodstuffs, were given out. These dealt with Philippine vegetables, milk, fertilizers, soils, paper materials, sugar cane, sugar from nipa sap, alcohol, agricultural, mineral, and industrial resources, etc.

Moving pictures made by the Bureau of Science illustrating the planting, cultivating, irrigating, harvesting, transporting, shipping, etc., of tobacco, rice, sugar cane, hemp, and coconuts; copra drying, cigar and cigarette manufactures, scenic views, etc., were shown and proved to be very interesting to the public.

Under date of March 31, 1917, the Secretary of the Executive Board of the Central Luzon Agricultural School, Muñoz, Nueva Ecija, wrote: "The Executive Board wishes to express its appreciation for the hearty coöperation furnished by the Bureau of Science during the week of the fair. Your exhibit of mineral and other natural resources was very instructive. Demonstrations of tanning hides were carried on. Your exhibit as a whole was very helpful."

GARDEN DAY

The Bureau of Science was able to participate in the Bureau of Education Garden Day held on January 27, 1917, at the Tondo Intermediate School. Two thousand seven hundred twenty special tickets providing for free admission to the Bureau of Science Aquarium were issued by the Bureau of Science to be distributed, three to each student that had successfully cultivated a garden during the year. During the evening an in-

dustrial, commercial, and scenic cinematograph film, prepared by the Bureau of Science, was displayed.

PHILIPPINE AGRICULTURAL CONGRESS

The Philippine Agricultural Congress was held in Manila, August 25–30, 1917. The Bureau of Science coöperated in every possible way to make the Agricultural Congress a success. A representative of the Bureau of Science was in attendance to answer questions of farmers and to direct them as to how they might best get the assistance of the Bureau of Science in solving problems that they desired to present. Fifteen articles that are of special interest to farmers were selected from Bureau of Science publications; copies were prepared in Spanish and were distributed at the Congress. The articles distributed were as follows:

1. Elementos más esenciales para el debido cultivo de las plantas.
2. Bambú, fibras y yerbas de Filipinas como materias para la fabricación de papel y para la obtención de la pulpa. Boletín de la Oficina de Ciencias para la prensa No. 53.
3. Origen de los elementos químicos existentes en los abonos comerciales.
4. Estado que demuestra los análisis de los vegetales más comunes de Filipinas usados como alimento tales como se adquieren en el mercado de Manila, su costo aproximado y valor alimenticio.
5. Estado que demuestra la composición de las leches frescas obtenidas en Manila.
6. Estado que demuestra la composición de la leche condensada azucarada.
7. Industria alcoholera de los trópicos. Boletín No. 63.
8. La hidrofobia o rabia. Boletín No. 28.
9. Pérdida de 15 millones de pesos en la industria coprera de las Islas Filipinas durante cinco años. Boletín No. 46.
10. La fabricación del azucar de 96 grados mediante el uso de cauas y tachos al vacio. Boletín No. 50.
11. La plantación y cultivo de la morera. Boletín No. 55.
12. Los desperdicios que tienen valor económico perjudican a los hacenderos. Boletín No. 57.
13. Modo de obtener muestras de tierra para su análisis. Boletín No. 64.
14. Productos alimenticios de los que se debe extender el uso. Boletín No. 69.
15. El abastecimiento de leche en las Islas Filipinas.

LEGISLATION

The Director of the Bureau of Science has proposed a bill providing for the technical education of Filipinos in the United States, one for the drilling of wells for the exploration of petroleum-bearing formations, one for the establishment of a marine and fresh-water products (fisheries) laboratory, and one for the leasing and development of mineral, except coal, lands

in the Philippine Islands. The following bills referred to him for study have been commented upon:

Law amending article one thousand four hundred eight-four of the Administrative Code whose object is the production of a fuel that is more economical, for industrial, agricultural, and transportation purposes.

Que concede ciertos privilegios a la fábrica de papel que primeramente se establezca en Filipinas, y que provee a otros fines.

Que concede un premio de seis por ciento anual sobre el capital invertido por la primera persona que estableciere dentro de dos años en Filipinas una fábrica de papel.

Que reforma el Artículo diez y seis de la Ley número dos mil quinientos noventa, haciendo extensivas a los habitantes de Nueva Vizcaya las disposiciones de dicho Artículo.

An Act to provide for the leasing and development of coal lands in the Philippine Islands.

Law levying income tax to subsidize national industries and providing for other purposes.

An Act to create a National Iron Company.

Ley de Minería.

Ley disponiendo una investigación de la geología de los terrenos públicos de las Islas Filipinas que contienen petróleo en cualquiera de sus formas y consignando fondos al efecto.

An Act to prohibit and penalize the cultivation or possession of the plant known as 'water hyacinth.'

Que prohibe el cazar, coger, herir o matar las aves comunmente llamadas 'garzas,' y que provee a otros fines.

Law organizing a national company for the exploitation of iron and steel.

A number of other projects concerning which legislation was contemplated have been studied and reported.

Mining legislation.—Much interest has been manifested in legislation concerning mining. The Bureau of Science from time to time has supplied a number of recommendations on various subjects relative to the mining industry. For a long time the Bureau of Science has been studying the defects of Philippine mining laws, and it is probably in a position to know and to learn more about needed changes than any other branch of the Government. The Philippine Islands are much in need of adequate special mining legislation, but in my opinion it is better to leave the laws substantially as they now are, until a competent man can be assigned to the problem and the whole of the mining laws studied and modified along the lines recommended by the Bureau of Science, in some such way as was done in the case of the Administrative Code.

MANUFACTURE OF TIKITIKI EXTRACT

Under the provision of Act No. 2376 the Bureau of Science has continued its work of preparing extract of tikitiki for the

treatment of infantile beriberi. A stock has been continually kept on hand; and during the year over 400 liters of extract have been prepared, probably sufficient to treat more than 8,000 infants, as compared with 300 liters of extract prepared in 1916, 200 liters in 1915, and 58 liters in 1914. This work is of very great practical importance, and the lives of thousands of children ill with beriberi have been saved by the administration of this prophylactic. The greater part of the stock prepared was distributed through the Liga National Filipina para la Protección de la Primera Infancia. Less than 8,000 pesos of the funds appropriated for this work have been expended.

PHILIPPINE ISLANDS MEDICAL ASSOCIATION AND IV ASAMBLEA REGIONAL DE MEDICOS Y FARMACEUTICOS DE FILIPINAS

Under the auspices of the Colegio Medico-Farmaceutico de Filipinas and the Philippine Islands Medical Association, the IV Asamblea Regional de Medicos y Farmaceuticos de Filipinas (Fourth Congress of Physicians and Pharmacists) will meet in a scientific and social section at Manila, February 4–8, 1918, inclusive. The congress promises to be a success in every way; and the Bureau of Science has already signified its intention of presenting chemical, botanical, serological, and other papers on various subjects associated with, or related to, medicine or pharmacy.

ANTITYPHOID AND SMALLPOX VACCINE FOR THE PHILIPPINE NATIONAL GUARD

Six thousand units of smallpox vaccine and 13,500 cubic centimeters, doses, or ampuls of antityphoid vaccine were furnished at cost for the use of the Philippine National Guard. An order for 13,500 cubic centimeters of paratyphoid A and B vaccine is now being filled for the same organization. An amount rather larger than usual of typhoid vaccine for prophylactic purposes for all demands has been prepared and issued.

INSTRUCTION FOR DISTRICT HEALTH OFFICERS

While not a teaching institution the Bureau of Science has continued giving an elementary course of common laboratory instruction to Philippine Health Officers who were assigned to, and reported at, the Bureau of Science for the work. The full course lasts six weeks and consists in bacteriologic analyses of waters and milk; examinations of fæces for parasites, cholera, dysentery, and typhoid; serum reactions; and examinations of sputum and pus. Seven assistant health officers during the year have taken the course wholly or in part with more or less profit to themselves. The time that some of them could devote to

the work was so short that they could do little more than study the Bureau of Science diagnosis folder and do assigned reading in the library.

TECHNICAL AND SCIENTIFIC EMPLOYEES

To make the service of the Bureau of Science of the highest quality, scientific positions should be filled by men of the highest training and ability. The supply of such men is limited, but they must be secured regardless of the compensation. Cheap men can be secured who can do certain classes of routine scientific work, but only well-trained men can properly interpret results and make the application to the large field of industry. No number of mediocre men can substitute a trained thinker capable of real constructive work. Able men who have been trained for, and are familiar with, the work of the Bureau of Science should not be allowed to leave on account of the inducements of greater salaries elsewhere. Only when an institution has a certain permanency of capable personnel can the work progress. The necessity for permanency of personnel in the Philippine Islands is felt more than elsewhere, because conditions are unique and technologists frequently must serve an apprenticeship before they become of great value. The Bureau of Science has been considerably handicapped by the loss of scientific workers, who have had long years of training and experience.

In practically every line of work the Bureau of Science is very much undermanned, and although the vision of what should be achieved is not dulled, the great volume of correspondence and routine work that has had to be carried on and accomplished has so nearly absorbed the personnel as considerably to limit the original results attained. I desire especially to express my appreciation of the coöperation and the devotion to their work of our able men, who in spite of many adverse circumstances have completed and prepared for publication the results of their original investigations.

The greater volume of work carried on in the Bureau of Science has continued along the lines designated by law as outlined in my preceding reports and will be indicated in the following pages:

DIVISION OF BIOLOGICAL LABORATORY

Personnel.—Dr. C. E. Gabel, Doctor Liboro, and Doctor Navarro resigned, the first at the end of a two years' contract and each of the others after about a year to engage in practice. Doctor Navarro was an especially well-qualified man, but the small pay of his position would not retain him in the service.

Routine.—Cholera has not made its appearance in Manila, due

undoubtedly to the work of eliminating carriers. In this task there has been close coöperation between the Philippine Health Service and the Bureau of Science, and it has been pursued throughout the year with unabated vigor. In Bilibid Prison, especially, so many cholera carriers were found among the skilled trades people that a serious financial loss was entailed by their isolation, but there was not a single case of cholera. In connection with this work about 163,000 fæcal specimens have been examined by the Bureau of Science for cholera.

The routine examinations of water, milk, blood, sputum, plague, leprosy, gonococci, foodstuffs, etc., have been performed in addition to the large number of examinations for cholera. There has been a slight increase in the quantity of specimens sent in by physicians in private practice, indicating an increase of confidence in the laboratory, which is a matter for gratification. The number of specimens in 1917, as compared with 1916, is shown in Table I, attached hereto.

Owing to our inability to procure Witte's peptone, we have been forced to adopt a peptone of other manufacture for bacteriological work. In performing the standard hygienic laboratory phenol coefficient tests for disinfectants, it is found that the test organism *B. typhosus* (Hopkins strain) grows more heavily in media made with these peptones and becomes somewhat more susceptible to the action of disinfectants. The results of tests are, therefore, slightly different from what would be obtained by the standard technic. Certain other peptones when used to dilute Witte's, even two parts to one, have given satisfactory results for the purpose of cultivating bacteria in perfect growth for the preparation of bacterial vaccines.

The Director of the Bureau of Science was able to render assistance to local practitioners in obtaining radium applicators and necessary screens from the United States for therapeutic work. There are now 40 milligrams of radium in Manila.

Sanitary Health Commissions.—The Bureau of Science has continued the supervision of the bacteriological work of the Sanitary Health Commissions, and in addition one assistant has been constantly detailed to duty with one commission.

Committees.—The Committee for the Examination of Lepers is composed of Doctor Johnston, chairman, and Doctor Wade, both of the Bureau of Science, and of Doctor Ordoñez, of the Philippine Health Service. Meetings are held on the second and fourth Friday of each month at San Lazaro Hospital. During the year ending December 31, 1917, examinations of 297 new patients and 182 reëxaminations were made, a total of 479.

The Typhoid Fever Committee, of which Doctor Wade is a member, submitted its preliminary report to the Director of Health on January 12, 1917, and its final report on April 30, 1917. From the latter I quote as follows:

> The distribution and histories of the scattered cases that have appeared conform to what may be termed contact cases. Serological tests made by the committee show that both typhoid and paratyphoid (B type) fevers are prevalent, apparently about equally * * *. The findings indicate a higher incidence of contact cases in Manila than in cities of the United States and Europe * * *. It is recommended that whenever it is possible to do so capillary tubes as supplied by the Bureau of Science for the purpose be used for the collection of the blood specimen, which should consist of at least 5 or 6 drops. The dried-drop method for local specimens is to be discouraged * * *. Finally an attempt to reach the physician is very desirable, that he may be induced to submit blood specimens for diagnostic reactions.

General.—Work with choleralike vibrios has been carried on throughout the year, and the results have been published. Also the results of the work in the treatment of cholera carriers and in the use of monkeys' blood in place of human in performing the complement fixation test for syphilis have been published. Studies in leprosy previously reported are still in process of investigation. Several times during the year, as heretofore, a bacteriologist of the Bureau of Science has been detailed on the trips for segregating lepers in order to perform the bacteriological examinations. During the last two months of the year a bacteriologist was detailed to the Culion Leper Colony to examin all inmates for intestinal parasites. The results of this work have yielded some very interesting data. In the routine examination of rats for plague no case was discovered, and no special investigation in plague has been carried on.

The study of pathogenic fungi and allied skin infections has been continued, and some of the results have been published. It consists of an investigation of certain little-understood factors of infection by pathogenic fungi, which are especially to be reckoned with in tropical pathology. The work is based on certain hitherto unclassified lesions found in the Philippine Islands, chiefly ulcerative and "pseudo-mycetomatous," and on experimental work with certain known fungi. From the first this has been seriously interfered with by the proneness of laboratory animals in Manila to die of peculiar conditions not referable to the inoculation. This fatal process, or disease, is so constant a development and in susceptible animals so serious and so suggestive of a hitherto unknown infection as to warrant the most careful investigation. Whether it is due to any special bacter-

ium, protozoön, fungus, or "virus" is not as yet determined. Several months' study makes it seem highly probable that knowledge of it will throw new and unexpected light on certain phases of tropical morbidity, probably more especially on infant mortality. Study of this is being carried on in conjuction with the main problem.

The published articles are given under the Philippine Journal of Science, Section B, on page 73.

SECTION OF SERA AND VACCINES

The new building to contain the operating and bleeding room has been just occupied, as indicated on page 4. Special mention was made on page 21 of the vaccine virus and typhoid and paratyphoid vaccines supplied to the Philippine National Guard. Arrangements were also made to perform Wassermann reactions for the Philippine National Guard at the rate of thirty per week. The biologic products from this section that were disposed of are shown in the following table:

Sera and vaccines bottled and disposed of at the Bureau of Science from January 1 to December 31, 1917.

Article.		Bottled.	Disposed of.
Antitetanic serum	units	1,862,000	3,764,300
Antidiphtheritic serum	do	56,500	72,000
Antidysenteric serum	cc	12,037	11,685
Antimeningococcic serum	do	590	510
Anticholera serum	do	16	13
Antityphoid serum	do		14
Normal horse serum	do	6,560	6,270
Typhoid vaccine	ampuls	14,532	14,483
Typhoid and paratyphoid A and B vaccine	do	340	600
Paratyphoid A and B vaccine	do		27
Dysentery vaccine	do		4
B. coli vaccine	do		20
Streptococcus vaccine	do	123	151
Gonococcus vaccine	do	2,368	2,426
Staphylococcus albus aureus vaccine	do	127	138
Staphylococcus aureus vaccine	do		18
Streptococcus-Staphylococcus aureus albus vaccine	do	246	299
Autogenous vaccine	do	46	46
Staphylococcus albus vaccine	do		35
Rabies vaccine		(a)	(a)
Vaccine virus	doses	1,181,685	1,338,469
Mallein	do		308

[a] The Pasteur treatment for rabies continues to be appreciated as shown by the following record of treatments:

Patients that received treatment at the Bureau of Science	101
Treatments sent by the Bureau of Science to out-patients	116
Total	217

The table shows that the products in greatest demand were vaccine virus, typhoid and paratyphoid vaccine, gonococcic vaccine, antidysenteric serum, antitetanic serum, and normal horse serum. The supply of the last two was almost exhausted during the year, and the demand for antidysenteric serum exceeded the supply. During each of several months more antidysenteric serum was dispensed than the total demand in the year 1913, and the greatly increased demand explains the inability to meet it in all cases. Already steps have been taken to double the output. The number of horses used for manufacturing serum has been increased to seventeen, which unfortunately is the full capacity of the quarters. It is much better to manufacture a limited number of sera in sufficient quantity and of good quality than to attempt the production of a larger variety of products. Antidysenteric serum, antitetanic serum, antiplague serum, and normal horse serum are the ones most extensively used by the local medical profession; and these should be produced by the Bureau of Science in preference to other sera, unless our present facilities and equipment are extended to about double the present capacity. Several horses must be kept continually under immunization for plague serum, since there is always the possibility of an outbreak of plague. From the demand of last year it is probable that all of the other horses will be needed for the production of normal serum, antitetanic serum, and antidysenteric serum and that none will be available for the production of sera of other kinds.

Rabies.—The Pasteur treatment against rabies (hydrophobia) is now much more appreciated than formerly. The number of patients who received the treatment in the Bureau of Science as well as the instances in which the vaccine is sent to out-patients by this institution in response to requests in the provinces have increased year by year. This appreciation and increase are due largely to the kindness of the newspapers in giving publicity to the bulletins of the Bureau of Science with regard to the efficacy of the Pasteur treatment and to the fact that it may be obtained from the Bureau of Science. There is a high percentage of fatalities among persons suffering from hydrophobia who do not receive treatment. No case treated at the Bureau of Science has ever developed the disease. In the provinces any person bitten by a dog should go at once to the nearest physician, preferably the district health officer, who may telegraph to the Bureau of Science requesting the Pasteur treatment, and the vaccine will be sent by the first mail.

The treatment consists of twenty-five (25) daily subcutaneous injections, made in the back or in the anterior abdominal wall of the patient, not in the arms or in the legs. During the treatment the patient may eat, drink, bathe, and in general live in his usual manner. Occasionally swelling and reddening at the site of injection and moderate fever follow the inoculations; these need not cause alarm, they may be expected. The material furnished for injection is emulsified in 50 per cent solution of glycerin, and should be diluted with an equal volume of physiologic salt solution merely to dilute the glycerin, thus reducing the pain after injection.

The Bureau of Science classification of persons bitten by dogs is made in the following manner:

(A) Those bitten by a dog that is clinically and microscopically positive, in which case treatment is urgently advised.

(B) Those bitten by a dog that is clinically positive and microscopically negative, in which case treatment is urgently advised.

(C) Those bitten by a dog the clinical history of which is unknown but which is microscopically positive, in which case treatment is urgently advised.

(D) Those bitten by a dog that was subsequently killed, the clinical history of which is unknown, but which is microscopically negative; in this case treatment is recommended.

(E) Those bitten by a dog that was not captured or was killed and not examined; in this case treatment is recommended.

(F) Those bitten by a dog known by the patient or identified and captured. In these cases the particular circumstances are to be considered. The first thing is to put the dog under observation (College of Veterinary Science). The patient may take treatment immediately or await the report of the veterinarian.

The character of the disease and its progress is duly explained to the patient in his own language, and if he decides to take the treatment, it is given immediately.

The customary practice at the Bureau of Science may be illustrated by the following instances:

Case 1.—A man reported at the Bureau of Science for treatment. Bite on the right forearm. He was the owner of two female dogs of good breed, both mothers of pups at that time. The man was trying to separate the dogs, which were fighting in his yard, and was bitten. The dogs were allowed to run at large, the yard being well fenced. The man was told treatment was unnecessary, but upon his insistance he was given 14 injections. The dogs remained in good health, also their owner.

Case 2.—A well-known veterinary practitioner was slightly bitten by a dog in his care. The dog showed no symptoms of rabies. Brother of this dog died of rabies recently. The veterinarian was advised to take treatment. He took the entire course of 25 injections.

Case 3.—An intelligent man brought a dead dog for examination and requested treatment. It was a pet dog not allowed to run at large, but died after two days' illness. Nobody in the house was bitten by the dog, but the proprietor claimed to have come in close contact with it and therefore desired treatment. Examination of the dog showed no evidence of rabies. Treatment was not given.

Case 4.—A young Filipino reported for treatment. He had rather a bad bite on his foot inflicted by a neighbor's dog. Upon inquiry the owner stated that it was a bad dog. Further questions as to the circumstances under which the accident happened brought to light the fact that the young man was bitten in the moment of climbing the neighbor's fence late at night. With the conviction that the animal was only a good watchdog, the patient was dismissed without being given Pasteur treatment.

Cases under heading (F) are further considered as to the location and severity of bites:

(1) Persons bitten about the head or upper part of the body are advised in all cases to take treatment immediately. Bites of this type are known to be most dangerous, and the patient must not lose time because the incubation period may be as short as that in a dog generally.

(2) Bites on the lower extremities are considered to be less dangerous and if very slight can await the result of clinical observation provided the latter is made by a veterinarian or other competent person.

From all this it is evident that conditions arise at times when awaiting the result of observation that would mean risk to the patient. The chances of preventing the horrible disease are decreased almost geometrically with the lapse of time between infection and the first treatment. If a dog has bitten more than one person, it is almost proof positive that it is mad.

SECTION OF BOTANY

Personnel.—There has been no change in the personnel or in the relations of Mr. E. D. Merrill and Dr. W. H. Brown with the University of the Philippines. Mr. Eugenio Fenix is to be retired effective at the close of the year. His ability, long experience, and acquired knowledge have made him a very valuable employee, and his resignation is greatly regretted. It will be difficult to find a satisfactory successor.

The time of Mr. Merrill should be entirely available to the Bureau of Science. He was originally assigned to the University for part time as an accommodation. The time necessary for teaching, lecturing, and supervising the botanical work for the University is lost so far as productive botanical work is concerned and seriously interferes with the work that he is especially prepared and fitted to do. Some change should be made, as his services are of very much greater value to the Phil-

ippine Government in connection with the botanical work that he is carrying on at the Bureau of Science than as a teacher of botany.

Exploration.—The accumulation of economic data and botanical exploration of, and extensive and valuable collections from, the unknown or little-known parts of Zambales, Rizal, Tayabas—especially that part formerly known as Infanta—and Camarines Provinces and Catanduanes Island have been made. This work should be extended by means of Filipino collectors to every unexplored part of the Archipelago. Dr. H. S. Yates has prosecuted field work in Rizal Province with special reference to fungi. He took the opportunity offered by his vacation to inspect the Botanic Garden at Buitenzorg and the mycological laboratories of that institution. He also visited Singapore, where considerable data on the rubber industry and the diseases of rubber plants were secured. He also made one extensive trip to Mindanao, Basilan, and British North Borneo for the purpose of investigating the diseases of the cultivated rubber trees and solving certain difficulties rubber growers have had in connection with the proper curing of the coagulated rubber. For the second time Mr. Merrill spent his annual vacation month in Kwangtung Province, prosecuting field work on Loh Fau Mountain, about 145 kilometers east of Canton, China. In seventeen actual working days he secured 544 numbers, represented by about 3,000 duplicates. This work was done in coöperation with the United States Department of Agriculture, Washington, D. C. Early in the year Mr. Merrill made a short trip to Taal Volcano to confirm certain results obtained by Doctors Brown and Yates in the preceding year regarding the revegetation of Volcano Island, the results of which are embodied in a published paper on The Revegetation of Volcano Island, Luzon, Philippine Islands, since the Eruption of Taal Volcano in 1911. Some coöperative work has been carried on for the Arnold Arboretum, Jamaica Plain, Mass., funds being supplied by Doctor C. S. Sargent, director of that institution, for carrying on field work under the supervision of the chief botanist of the Bureau of Science for the purpose of collecting representatives of the woody plants of the Philippines. By this arrangement the Bureau of Science retains one set of the material, the duplicates being forwarded to the Arnold Arboretum for disposition by that institution. Mr. M. Adduru, a student in the University, was employed in this work during the long vacation, and made a valuable collection in Cagayan Province, Luzon, in May and June.

Systematic investigations.—The time of Mr. Merrill has been

largely devoted to classifying the Philippine flora. The Philippine material is given precedence, and the current collections are practically all identified. Most of the work on extra-Philippine material has had to be done outside of regular office hours. The printing of Mr. Merrill's critical paper entitled An Interpretation of Rumphius's Herbarium Amboinense necessitated a very great deal of proof reading, since an attempt was made again to check every reference on the original source. The United States National Museum, Washington, D. C., which is familiar with this work, states in its 1916 report, page 43, that it "will be of great value as affording a satisfactory basis for the proper understanding and identification of many closely related species from other parts of the East Indian region which have often been recorded under untenable names." The manuscript of Mr. Merrill's critical revision of the Philippine species described by Blanco and by Llanos was submitted to the printer shortly after the middle of the year and is now well advanced in first proof. At various times during the past six years Mr. Merrill has been working on a list of Bornean plants and now has the systematic enumeration and the preparation of a bibliographical index nearly completed. An attempt has been made to account for every species that has been reported from Borneo in botanical literature, in addition to those that are represented by actual specimens in the Bureau of Science herbarium. This work will render future work on the Bornean flora comparatively easy, as all bibliographical data will be accessible in one place. The Bornean references are scattered through nearly 600 published papers.

With the completion of these three subjects it is planned to start the preparation of a new dictionary of plant names in the Philippine Islands and a critical enumeration of all known Philippine species, with an adjustment of the synonymy, in preparation for the final undertaking, a general flora of the Philippines. It may be possible to combine the Filipino names with the systematic enumeration, thus making a single publication that will include all the technical and local names credited to the plants of the Archipelago. The only place in the world where the data for this undertaking are available is in the card catalogue of the Bureau of Science, and the work can be done only by the individuals familiar with, and in a position to consult, the index. The work involved in this undertaking will be very large. The literature of Philippine botany is vast, the references are widely scattered, and the number of titles involved will approximate 2,500, from about the year 1600 to the present date. It is hoped

that sufficient time and competent assistance will be available to complete the work within a reasonable time.

Mycology.—The additions to the mycological collections in the past year have approximated 450 numbers, but due to the impracticability of shipping material to Europe, only about 200 numbers have been sent to specialists.

Some fungi causing diseases of economic plants submitted by employees of the Bureau of Agriculture and by others have been identified. Two diseases of the rice plant, not previously reported from the Philippines, have been discovered. A rot of the sweet potato, caused by *Rhizopus nigricans*, has been found on camotes. *Corticium salmonicolor*, the cause of well-known diseases of rubber trees, tea, etc., has been found to be the cause of a rather serious disease of *Citrus* (the oranges) in the Philippines. A preliminary study has been made on a disease of the abacá plant, apparently caused by a bacterium.

Physiology.—The work in plant physiology has been carried on by Doctor Brown, who is detailed to the Bureau of Science from the University for part time. The task of correlating, interpreting, and compiling the results of the field work completed on the problem of the relationship of physical types of vegetation to the environment on Mount Maquiling in 1915 and the similar but less extensive data secured on Mount Banajao in 1916 is nearly completed. A complete description of the data relating to the vegetation has been written, so that this part of the work is now ready for publication. All that remains to be done on this important problem is to write the interpretation of the data on the environmental factors.

Medicinal plant survey.—The work on the local medicinal plants and their uses was delegated to Dr. Leon Ma. Guerrero, and satisfactory progress has been made. A special form was prepared, which was sent to various officials in all parts of the Philippines. I desire to thank several hundred voluntary contributors, who have filled in and returned over 1,200 of the blanks and at the same time have submitted specimens of the various species in order that the proper identification could be made. About all the available empirical data that can be obtained by this means has been secured, since the forms received this year, so far as the species are concerned, have merely largely duplicated those received in the preceding year. Most of the species regarding which data have been received are the most commonly utilized medicinal plants that grow in towns and in their immediate vicinity.

Work on the accumulation of data regarding Philippine

medicinal plants should be prosecuted with vigor. As soon as they can be correlated with chemical, pharmaceutical, and physiological studies of the active constituents, the results should be published. Results obtained by the organic chemists from a study of a selected list of species have been already published. This work should and will be continued, provided chemists are available for it. It is clear that original investigations regarding unknown drugs cannot be made by chemists who are versed only in ordinary routine methods, but must be done by individuals trained and experienced in research methods. The chemist must be able to determine whether or not the substance he isolates is new, or whether it pertains to compounds already isolated by other investigators either from the same or from different plants.

The herbarium.—Although general world conditions have militated against botanical exchanges in the past year, as in other years since the outbreak of the present war, the growth of the herbarium has been eminently satisfactory. It has been largely rearranged during the year, all material from China, Japan, and Formosa having been segregated in yellow-labeled genus covers, so that the material on the three different areas on which work is now being prosecuted—the Philippines, Borneo, and China—is readily accessible. The growth of the herbarium is causing a very crowded condition of the specimens, and it will be only a short time before the herbarium will outgrow its present quarters and provision must be made for its expansion. The following valuable material, which has all been classified and identified by Mr. Merrill, has been secured by collection and by exchange.

Philippine accessions.—Specimens by collection, submitted for identification and transmitted from other bureaus, notably from the Bureau of Forestry, are:

Collections, employees of the Bureau of Science	6,555
Collections, employees of the Bureau of Forestry	728
Miscellaneous collections of Messrs. Copeland, Lete, Adduru, Santos, Vanoverberg, Quisumbing, Wester, Baker, and Weber	781
Total specimens	8,064

Foreign accessions.—The exchanges of necessity for the most part have been confined to the few botanical institutions in the Orient. No exchanges have been received from Europe, and but few specimens have been received from the United States. The extra-Philippine specimens accessioned are as follows:

West Indies, E. W. Broadway, exchange with Missouri Botanical Garden	90
Kwangtung plants, C. O. Levine, for identification	1,800
Hainan plants, Margaret Moninger, for identification	80
Formosan plants, R. Kanehira, exchange	193
Bornean plants, collections of Messrs. Villamil, Agama, and Wood, British North Borneo Forestry Service	283
Malay Peninsula plants by exchange with I. H. Burkill, Botanic Garden, Singapore	314
Australian plants, Botanic Garden, Brisbane, exchange	440
Chinese plants, collected by Meyer, by exchange with United States Department of Agriculture	232
Chinese plants, exchange with the Botanic Garden, Hongkong	323
Hawaiian ferns, exchange with the New York Botanical Garden	36
Hawaiian plants, exchange with the College of Hawaii	60
Bornean plants, collected by H. S. Yates	117
Chinese plants, collected by E. D. Merrill in coöperation with United States Department of Agriculture	544
Malay Peninsula plants, exchange, Calcutta Botanic Garden	135
Total	4,647

The total accessions for the year are 12,711 specimens; which have been poisoned, mounted, and so distributed as to be available for consultation and study. There are now 185,229 specimens in the herbarium, of which about 77,700 are extra-Philippine, the remainder being Philippine material.

Coöperative work has been continued with the officials of the Forestry Service, British North Borneo, on the Bornean flora, collections made by them being transmitted from time to time for study and report. The botanical work established at Canton Christian College, Canton, China, under the immediate direction of Mr. C. O. Levine, and largely as the result of a vacation trip made last year by Mr. Merrill, has resulted in the collection of a large series of specimens, 1,800 having been submitted for study and report in the past year. This work is now well established and will prove to be of distinct value to the Canton college, as well as being the source of much valuable botanical material for the Bureau of Science.

Robinson Memorial Fund.—A grant of ₱100 from the first income from the fund established by the New York Botanical Garden in memory of the late C. B. Robinson, formerly a botanist of the Bureau of Science, has been made to Mr. Merrill for furthering botanical field work in Guam. The allotment has been sent to Mr. Peter Nelson, of the Guam Experiment Station,

who has agreed to devote his vacation time to the field work gratis, utilizing the money for hiring the necessary labor and field assistants.

Distribution of duplicates.—No general distribution of accumulated duplicates has been made on account of the unsatisfactory, and to European countries unsafe, conditions as to transportation. There has not been enough clerical help to complete the labels and make up the sets. A total of 7,573 specimens has been distributed for all purposes, most of which have been sent out on our general exchange accounts. One hundred thirty-eight were for purposes of identification, and fifty mounted specimens have been loaned to specialists for study. Five hundred seventy-eight identified mounted duplicates of material collected by employees of the Bureau of Forestry have been returned to the Bureau of Forestry for distribution to the forest stations in the provinces.

Publications.—A number of papers have been prepared and published on the Philippine flora; one paper has been prepared on the Bornean flora, and one on the Kwangtung flora; and two additional ones on the above extra-Philippine regions are practically completed. The most important single publication, and probably the most important individual piece of botanical investigation that has been carried on in the Bureau of Science, is An Interpretation of Rumphius's Herbarium Amboinense, issued November 1. Species Blancoanae: A Critical Revision of the Species of Plants Described by Blanco and by Llanos, on which work has been prosecuted during the past five years, was completed and is now in press. A Bibliographical Index of Bornean Plants, which is nearly completed, is to be published in Singapore by the Sarawak Museum. A list of the papers that have been published in Section C, Botany, of the Philippine Journal of Science, is given on page 74.

SECTION OF FISHERIES

There has been no change in the scientific personnel. Information or advice with regard to pearl fishing, trepang, bangos culture, methods of fishing, canning sardines, and related subjects has been given in reply to oral and written inquiries. As an illustration of the kind of information asked for and given, I present the following:

December 6, 1917.

Dr. ALVIN J. COX,
Director of the Bureau of Science, Manila.

MY DEAR DR. COX: With reference to our conversation last evening I would be greatly obliged if you could furnish me with any data which

you may possess regarding the fish and particularly sardine industry in the Islands. The information I desire is to be used with a view toward the erection of a canning factory for these products. I would like to know, if possible, the size and quantity of fish obtained and the prices paid and the best method of obtaining them. I will be very grateful for any information which you can give me on this subject.

Yours very truly,

(Sgd.) PHILIP W. GIOVANNINI.

December 7, 1917.

Mr. PHILIP W. GIOVANNINI,
c/o Modern Vulcanizing Plant, 67 Calle Echague, Manila, P. I.

SIR: I have the honor to acknowledge your letter of December 6, 1917, inquiring "with regard to the fish and particularly sardine industry in the Islands," and in reply thereto I have the honor to furnish the following information:

Sardines are found in Manila Bay and in certain other localities in the Philippine Islands in such quantities that, in my opinion, would warrant the establishment of canneries. A former employee who was fish expert of this Bureau for ten years states: "Sardines are more abundant here than in the water of Monterey Bay, California."

We have the following species of sardines. These have thin deciduous scales, and are rich in oil. The size given is for the adult fish and includes the head and tail.

	Length in inches.
1. *Dussumieria liogaster*	7
2. *Dussumieria clupeoides*	5.75
3. *Dussumieria acuta*	4 to 6
4. *Dussumieria hasseltii*	4.5
5. *Dussumieria elopsoides*	4 to 5

Also two species of very small sardines whose total length, when adult, is 3 inches; these are

1. *Stolephorus gracilis,*
2. *Stolephorus delicatulus.*

In addition to the above true sardines we have a large number of small clupeoid fish, which, I understand are allowed under the pure food law to be labeled "Sardines," although they are in fact small herring.

	Length in inches.
1. *Sardinella moluccensis*	6
2. *Sardinella gibbosa*	5
3. *Sardinella sundaica*	5.5
4. *Sardinella vanicoris*	5
5. *Sardinella sirm*	5.5
6. *Sardinella longiceps*	5
7. *Sardinella klunzci*	4.5
8. *Sardinella indica*	4 to 5

Experts pronounce these as good as the French or Norwegian sardines.

These fish are caught by the Filipino fishermen, or the Japanese, and are sold in lots to the highest bidder. They are not sold by weight; simply a bid is given on a boatful, or a boat half full. The price is low, but I cannot say what it would be for a ton. They are bought chiefly by the Chinese, who have large drying and smoking establishment near the beach.

Alcoholic specimens of all of these species are on exhibit at the Bureau of Science and in the United States at Standford University, Department of Zoölogy, Palo Alto, California, where they may be examined.

Ordinary common labor, suitable for a canning enterprise, would cost between ₱10.00 and ₱20.00 per month, per person.

Coconut oil is manufactured in Manila in large quantities, but most of it is not a grade that could be used for sardines. More and more high-grade edible oil is to be manufactured here. Olive oil and soya bean oil would cost about the same here as in the United States. There are large quantities of peanuts grown here and I have been told that peanut oil is to be manufactured by at least one company. The Filipinos prefer their sardines in tomato sauce. Tomatoes grow well here, and this would be the cheapest material to use.

The cost of salt.—The native salt can usually be secured for from 50 cents to $1 (U. S.) per hundred pounds. Of course the price varies with the season and is cheapest when there is a long prolonged dry season. The cost of a salt plant is not great. The refined Liverpool salt, at the present time, is quoted at $2 to $3 per hundred pounds.

The import of sardines to the Philippine Islands for 1915 was ₱138,485 ($69,242.50 U. S. currency).

Regarding the quantity that could be sold, I am unable to give any definite information, as this would depend upon your price, the salesman, attractiveness of the pack, etc. I believe, however, a good market could be established, both here and in China.

The tuna is found here; also a number of other fish well adapted to canning purposes; such as the Spanish mackerel, or King fish; Japanese mackerel; and several species of the Pompano family.

There are a fair number of sperm whales seen at times about these Islands, also we have records of schools of black-fish, small whales being stranded, but we have no data to indicate how abundant whales are in the waters of these Islands.

Hoping that this information will be of service to you, I am

Very respectfully,

(Sgd.) ALVIN J. COX,
Director, Bureau of Science.

The collection of fishes has been increased by 400 specimens, which include many species not known heretofore in Philippine waters. The sponge collection has been rearranged and is now properly displayed. A collection of sharks has been also placed on exhibit. The reptile and batrachian collections are being classified and catalogued for the first time. Small collections of reptiles were classified for the Ateneo de Manila and the University of Santo Tomas. The identifications of reptiles sent in by various persons, including one specimen from the Philippine General Hospital, were made, and information regarding their poisonous nature was given. A collection of land and sea shells was classified for Mr. C. M. Weber.

One exploration trip with regard to sponge, pearl-shell, and fish industries and possibilities, etc., was made in southern waters

during the year. The study included the present condition of the pearl fisheries and resulted in determining something of their life history, rate of growth, distribution, etc. Further information is necessary before any modification of existing regulations governing their collection in regard to size, method of measurement, etc., can be considered. The question of the method of measuring the shells has come up several times in past years, and it is believed wise to settle this point by an investigation on the ground. The fish expert has also given a few addresses on fisheries industries in the Philippine Islands.

Black bass.—The imported black bass continue to do well in Baguio Lake. Two lots of small fry were brought to Manila and distributed to Lake Lanao, Mindanao; Laguna de Bay near Talim Island and two lakes near San Pablo, Laguna; and to an artificial lake in Ilocos Norte. The possibility of breeding black bass in Manila is still being studied. In the hope of inducing the stock to spawn, the bass pond on the Bureau of Science grounds was deepened by providing a concreted cistern near its center; the latter also facilitates the removal of all *dalag* (mudfish) when the pond is drained.

Mosquito fish.—The supply of mosquito fish for distribution is continually kept on hand, and the fish have been distributed to those who have applied.

Aquarium.—The large sea turtles that have been so difficult to care for have been dispensed with, and the consumption of sea water has been much reduced. Some of the interesting acquisitions made during the year were a rare soft-shelled turtle, *Dogiana subplana;* fresh-water turtles; ray fishes (selachians); a large, rare boxfish; etc. One tank of blue fishes was accidentally poisoned by the boxfish and all of them died. This tank of blue sapphire fishes has been renewed and is more beautiful than before. Compare also "Aquarium," page 5.

Publications.—Published articles are given under the Philippine Journal of Science, Section D, on page 75. Bureau of Science Press Bulletin 76, entitled Fish and Fish Products, which discusses the preservation of fish products, was released on August 29, 1917. Putrefaction, which is responsible for deterioration, is caused largely by bacterial agencies, and it takes place most rapidly under favorable conditions of heat, moisture, and air. Preservation of products has to do with removing one or more of these conditions favorable to the growth of the decay-causing bacteria or introducing unfavorable conditions. The four methods discussed are refrigeration, which excludes heat; drying, which removes the moisture; canning, which keeps

the product from the air; and the use of antiseptics, which destroys or prevents bacterial growth. Bureau of Science Press Bulletin 81, entitled On the Methods of Preserving, Drying, Salting, Smoking, or otherwise Utilizing Food Products, was released on October 20, 1917. Each of these press bulletins has been very favorably commented upon by the public. Largely as a result of vacation collecting and study, Mr. Taylor has nearly completed catalogues of Philippine frogs, snakes, and lizards, respectively. It is expected to extend industrial experimentation during the next year and to prepare as many of the results for publication as possible.

Extension.—Marine exploration and fish culture work should be extended. See page 9.

SECTION OF ORNITHOLOGY AND TAXIDERMY

The scientific personnel remains unchanged. The working collection of bird specimens has been augmented by specimens of Philippine species that were collected incidental to field work in connection with the investigation of damage to rice crops in Laguna Province, specimens received in exchange for duplicates, etc. Several specimens of rare birds, including a monkey-eating eagle, have been also added to the collection. The entire working collection of study skins has been overhauled and rearranged, so that the specimens of any desired species can be promptly examined. No damage by insects has been discovered, and the whole collection shows excellent preservation. A few specimens have been mounted and added to the demonstration series of typical Philippine birds. The important study of the food of birds in order to determine their economic status has been continued.

The Bureau of Science has done what it could to prevent the taking of birds' eggs of any species at any time. Eggs of any but of a very few Philippine wild birds are small, and therefore their food value is trifling. On the other hand, most species of birds themselves are not injurious but are actually very beneficial to the farmers.

Value of collecting and studying birds.—Every progressive government realizes the practical value of birds to farm, orchard, and forest and takes pride in having a representative collection of bird specimens. Such governments employ ornithologists to learn what species of birds live in the territory and to study the distribution, migration, and food habits of their birds in order to know their value. The formation of a scientific collection is a necessary part of such a study and is carried on

simultaneously with it. At the same time any other useful data such as the abundance, character of country inhabited, relations to other species, nesting time or other habits, etc., for all species of birds that will be of interest or guidance in the passage of intelligent laws for protecting useful birds should be gathered, as it requires little extra time or effort. The second duty of an ornithologist is to help disseminate to the people the collected information with regard to birds. When people realize the value and the usefulness of birds, they will be in sympathy with protective laws, and there will be no difficulty in the enforcement of such laws.

The economic status of a bird species cannot be determined by isolated notes made in one place at one time. A crow may kill a chicken, but this fact does not justify the statement that all crows kill chickens at all times and that crows eat only chickens. Trustworthy evidence can be obtained only by the examination of the stomach contents of a large number of individuals collected throughout the year and at different localities, supplemented by field observations. Nearly all birds are beneficial at times and injurious at other times. The economic problem is to balance the injuries against the benefits and to decide in so far as possible which are the greater. The ratio of animal to vegetable food varies with the time of the year, and this makes it necessary to examine a series of stomachs for each month for each species in order to obtain a complete knowledge of its food and of its depredations. The economic status of a bird cannot be determined upon circumstantial, partial, or insufficient evidence as to its food. Contrary to the opinion of most people hawks and owls of the United States have been shown to be not only not injurious but decidedly beneficial, because the greater percentage of their food consists of insects and of rats, mice, gophers, and other small mammals.

In view of these facts and the limited force of the section of ornithology of the Bureau of Science the best data on the food habits and other economic results can be probably achieved; first, by continuing to make comprehensive collections of birds in various parts of the Archipelago, thus acquiring more knowledge of the distribution of Philippine birds; secondly, by collecting especially a few of the commoner species in quantity throughout the year; and thirdly, by field observations on abundance, migration, nesting, etc., especially of the commoner species. When enough data are collected and interpreted, the results will be of help to agriculture and forestry. For this purpose we are throughout the year accumulating and studying especially

stomach contents of the following abundant, widely distributed, and well-known groups of species and of the rarer and less well-known species, when no loss of time is entailed:

Crows.—Crows are known to do much damage to various crops, and it is desirable to learn if they are of any use whatever.

Mayas (rice birds).—Under the general name "mayas" are included several distinct species that are generally condemned as destructive to growing rice. They undoubtedly do much good as weed-seed eaters. One species, *Amandava amandava,* has in some way been introduced recently and seems to be thriving in Luzon. Information on its status is desirable.

Doves and pigeons.—The very large number of doves and pigeons, both in species and individuals, and their well-known grain-and-fruit-eating habits make of them a great economic factor. Some of the forest species of doves undoubtedly play a valuable part in the distribution of seeds of forest trees.

Cuckoos.—The cuckoos are very effective in the destruction of insects, especially of caterpillars. It is probable that all the cuckoos are entirely beneficial.

Hornbills.—The hornbills are all large birds, and their stomach capacity is enormous. They eat both fruits and insects. They are perhaps important in the distribution of seeds as well as in the destruction of insects.

Wherever possible a determination of plants, insects, etc., found in the stomach contents is made. Also the collecting of seeds and fruits eaten, or suspected of being eaten, by birds, and of the botanical material by which the seeds and fruits may be identified, is important. The collecting of insects is also an aid in the identification of insects eaten by birds. Experiments in the feeding of captive birds should be made to determine food preferences, amount of food taken, rate of digestion, etc.

The Bureau of Biological Survey of the United States has examined over 60,000 birds' stomachs, and the collected data have been published. While the great economic importance of birds has been recognized in Europe and in the United States, very little has been done with the species of the Philippine Islands. There are a few papers on the food of India and Australia. A brief and suggestive paper by S. H. Koorders [*Kon. Akademie v. Wetenschaffen,* Amsterdam (1909), 108–16] records the seeds found in the stomachs of eighteen birds collected in Java. The ornithological work done by foreigners in the Philippine Islands has been in the hands of those whose chief aim was to secure new species rather than new information about old ones. R. C. McGregor [A Manual of Philippine Birds. Manila. *P. I. Bur. Science Pub.* (1909), No. 2] records brief statements of the food of a few species. D. B. Mackie [*Phil. Agr. Rev.* (1913), 6, 541] has contributed something concerning the

value of birds in the control of locusts, but unfortunately he does not give the names of the birds.

Taxidermy.—The services of the taxidermist and his assistant have been in demand by the public more than during any previous year. Specimens handled have included mounting a large shark, four tamarao heads, three carabao heads, and numerous small birds; cleaning, preserving, and packing skulls, horns, skins, etc.; and tanning large snake skins, goat skins, a tiger's skin as a rug, etc.

Special.—Employees of this section of the Bureau are trained to collect botanical specimens and various classes of zoölogical material. Specimens acquired in this way are at no additional expense to the Bureau, and such of them as cannot be identified here can be sent to specialists, who are thus induced to work on Philippine problems at almost no expense to the Government, provided that the latter publish their results when completed. Zoölogists and botanists, in general, recognize in the Philippine Journal of Science a medium through which they can have their papers published in approved style. On the other hand, the Government secures at slight cost the services of the highest authorities, men that it could not afford to hire as regular employees. It is a very great advantage to the Government and to all scientists to have this material here. The ornithologist being a man possessing a large amount of general information had to prepare memoranda and answer correspondence on a large number of general subjects that did not belong to any one specific division.

Publications.—A comprehensive index to the generic names of birds has been put into final shape. This index lists nearly 8,000 generic bird names with the volume and page references to 41 volumes that are the guides to systematic ornithology. This work will save a great amount of time whenever it is necessary to refer to the literature of any genus of birds. One paper, recording certain Philippine game and shore birds, has been prepared for publication.

SECTION OF ENTOMOLOGY

Many problems involving coöperation between bacteriologists, entomologists, marine biologists, and others are continually coming up to show the necessity for close relationship between these scientists. For example, it was claimed that the use of petroleum and disinfectant in fish ponds in order to prevent the breeding and propagation of mosquitoes caused the death of the

fish that were grown there. It is also maintained that the injurious mosquitoes did not breed in the ponds where the water was constantly changed by the flow and ebb of the sea. Since the bangos industry is of such great importance to the Philippine Islands, the fish expert was detailed to carry on an experiment to settle this problem and actually to determine whether the use of petroleum to prevent the breeding and propagation of mosquitoes actually causes the death of the fish that are bred in the pond. Many similar inquiries and other entomological queries are continually being received, and such information as is possible has been given in response. Such work as is not connected with some other regular branch of the Bureau, as has been done, has been carried on under the supervision of the ornithologist. No appropriation has as yet been made for this important work, although entomologists are very much needed.

During the year two specimens of a spider that has caused the death of cattle or carabao in Mindoro and in Occidental Negros have been brought to this laboratory. One of the specimens was sent to the United States National Museum, Washington, D. C., for identification. The spider is *Lathrodectes hasseltii* Thor., widely distributed in Malasia from India to Australia. The specialist states that an allied species "occurs through North, Central, and South America. There is no doubt that the bite of this spider may be much more serious than that of most spiders. There is, however, some doubt that the poison is at all time equally virulent. It seems rather extraordinary that its bite could cause the death of a carabao and even that it could pierce the tough skin of such an animal. If, however, the bite were upon some mucous membrane, as the lip or the eye-lid, death might possibly result."

Bat roosts.—Many insects fly only at night. This habit may have been developed because of the danger of daytime flight. There are some birds that eat night-flying insects, but they are few. Fortunately certain small mammals, the bats, have acquired the power of flight, and these are busy when most of the birds are asleep. The large fruit bats are not known to be of any benefit to man, but the very small bats feed exclusively on mosquitoes, moths, and other night-flying insects. These animals spend the day in caves, hollow trees, cracks in walls, and similar hollows. From a bat roost, if long occupied, actually tons of guano can be removed. Here is an animal that destroys one of man's worst enemies, the mosquito, and produces therefrom one of the most useful products.

In Texas colonies of bats have been induced to move into

especially constructed roosts in malarial districts, with the result that these districts are now healthful and perfectly free from mosquitoes. The Bureau of Science is encouraging the building of bat roosts in the Philippines as an aid to the destruction of mosquitoes. The Bureau of Science has prepared plans for a bat roost and a bill of materials for the same, which it distributes to any one who will erect a roost. A few copies of the plans have been already distributed.

Bamboo borers.—Many believe that borers lay eggs "in the young growing bamboo and that if the bamboo is not cut until after the eggs hatch the sap kills the young borers and they are unable to do any damage. If the bamboo is cut and becomes dry before the eggs hatch, the young borers remain alive and eat the bamboo." The borers do not lay their eggs in growing bamboo. The eggs are laid in bamboo after it is cut if there is attractive food stored there. If bamboo is thoroughly ripe before it is cut, there is no sugar or starch in the wood, and it is, therefore, not attractive to the borers and is not attacked by them. If immature bamboo is cut, there is enough starch in the wood to serve as food for the borers; therefore eggs are laid in it.

Silk.—The Bureau of Science has introduced silk culture in the Philippine Islands and in recent years has repeatedly called attention to this as a promising industry. It has been demonstrated conclusively that silk of excellent quality can be produced at a profit. Several pamphlets have been published describing the industry and instructing the smaller farmers as to the best methods. Cuttings for mulberry plants can be secured free of cost from the Bureau of Agriculture. Bureau of Science Press Bulletin 55 gives brief instructions for planting and caring for the slips. The feeding and rearing of silkworms is a continuous process at the silk house of the Bureau of Science, and a girl may learn the details here at any time. The stock of silkworms has been maintained throughout the year. Silkworm eggs are supplied by the Bureau of Science free of cost to any applicant who has growing mulberry plants, a silk house, and a trained person to care for the worms, or a person who understands the care and rearing of these insects. The model silk house at the Bureau of Science may be seen at any time. The industry can be easily taught to women, especially housewives, who have sufficient spare hours to devote to it. The efforts of the Bureau of Science toward the propagation of the silk industry in the Philippine Islands are accomplishing some results. A large number of silkworm eggs has been distributed in Min-

danao, Negros, and Luzon during the year. Letters of information have been written in answer to inquiries about the silk business, and considerable assistance and careful details and instructions have been given to those interested, which should help to make the culture of silk in these Islands a success. The rearing of silkworms is capable of being developed into a large industry in the Philippine Islands, but there is little hope of its being a success until there is a Government silk expert to oversee the work of demonstrators, who should introduce the work into various localities. Without a sericulturist to guide the work, there is grave danger that the industry in the Islands will be descredited, if it is not an entire failure. An appropriation should be made available to the Bureau of Science for this and other entomological work.

In March the Bureau of Science received Dr. D. E. Douty, general manager of the United States Conditioning and Testing Company of New York, who was on his way to Japan and China in the interests of the silk association of America. Through the Bureau of Science he has been made acquainted with the possibilities of the Philippines as a future source of supply of raw silk for the silk-manufacturing industry of America.

CHEMICAL LABORATORY

Personnel.—See Division of General, Inorganic, and Physical Chemistry and Division of Organic Chemistry.

INVESTIGATION

Although the time of the chemists has been so occupied by routine work, particularly during the last few months, that it could not be completed during the regular working hours, still several studies have been finished and other investigations are in various stages of completion. Men in this branch, as in other lines of scientific work, are of the greatest value only when their work is so arranged that they can devote considerable time to careful study. The investigations are all directed along the lines of Philippine industry and development.

Lime.—In the weekly Bureau of Science report for the week ending October 13, 1917, I said:

> Sugar milling is about to begin, and as in previous years there will be a large demand for good lime. The lime of local manufacture is burned in a crude manner and seldom contains 25 per cent of available lime. Such a product is often used for ordinary construction work, but it is not at all suitable for chemical purposes such as is required in the manufacture of sugar. At present most of the lime used in Philippine sugar centrals is imported from Japan at a high price. In many cases the

imported product does not meet the demand in either quantity or quality. Coralline and crystalline limestones suitable for the manufacture of lime occur throughout the Archipelago, and there is no reason for the importation of lime into the Philippine Islands. In order to show the practical application of our excellent limestone deposits and how profitable it would be to the people to establish modern limekilns, the Bureau of Science has built one for experimental purposes. An experimental run is now being made in this kiln, and it produces 1.5 tons of lime in twenty-four hours. Good lime such as is produced in the experimental kiln of the Bureau of Science has a market value of ₱40 per ton without the container. Any one interested in the manufacture of lime may apply to the Bureau of Science for a copy of the plan of the experimental kiln.

This experiment of the Bureau of Science has created a great deal of interest. Its object was to show the suitability of the coralline and crystalline limestone from various parts of the Archipelago for the manufacture of lime. Calcination tests on Binangonan, Montalban, and Cebu limestones have been completed with very encouraging results. All of the lime produced was sold, though this was only a secondary object of the work. In all about 17 tons of high-quality lime were disposed of to the Philippine Tannery, Philippine Acetylene Co., and to hacenderos. The supply did not, in the least, meet the demand. I have received many letters from individuals who desired to purchase lime and who asked for copies of the plan of our kiln. Every one who has visited the experimental kiln has been much pleased.

Salt.—The Bureau of Science has received many inquiries with regard to the manufacture of salt. To answer these, the Bureau of Science has prepared a blue print showing a probably satisfactory design for a plant for making salt from sea water by the Chinese process. A memorandum on the manufacture of common salt from sea water prepared in this Bureau gives the following information:

There are three methods used in the Philippines for evaporating sea water in the manufacture of salt, but of these the most important and best adapted commercially is the so-called "iras inchik," or Chinese process.

An estimate of a plant in the vicinity of Manila shows the approximate cost and production for a surface are of 10,000 square meters to be as follows:

	Pesos.
10,000 square meters of swamp land	300
Excavation, leveling, and construction of dikes	2,000
Materials for crystallizing vats and labor	1,100
Warehouse	300
Miscellaneous expenses	200
Working capital	500
Total	4,400

Cost of operation:	Pesos.
4 laborers at ₱25 per month each for 5 months	500
1 foreman at ₱40 per month for 5 months	200
Maintenance	100
Interest at 8 per cent per annum	352
Taxes on the salt works and salt produced	66
Total cost of operation	1,218

The amount of salt that can be produced in five months of operation, from December to April inclusive, will be about 4,350 cavanes at a cost of 28 centavos per cavan. The weight of 1 cavan of salt is about 50 kilograms. Of course, it must be kept in mind that the production varies from year to year, depending on the amount of interference by the rainfall and occurrence of cloudy days.

Caustic soda.—The present war has brought about a shortage of this chemical, which is one of the most used in Philippine industries, about 1,500,000 kilograms being imported annually for the manufacture of soap and for other purposes. This quantity at the wholesale price prevailing in the New York market on November 20, 1917, would be valued at approximately ₱525,000, though in Manila it would cost much more. The Bureau of Science has done all within its power to encourage the manufacture of caustic soda in the Philippines. Under date of August 15, 1917, in response to a request for the same, the Bureau of Science prepared a lengthy memorandum, which discusses the various methods for the manufacture of caustic soda in relation to Philippine conditions such as fuel, cost, market, etc. This information is available to any one interested; and the figures show that the manufacture of caustic soda is a commercial possibility, even when the by-products are not taken into account and conditions return to normal. Needless to say, this industry would stimulate other manufactures such as lime, salt, bleaching powder, chloroform, etc.

Bleaching powder and chloroform as a denaturant.—Chlorine is a by-product of the manufacture of caustic soda, and besides being utilized in the elementary (liquid) condition, it may be disposed of in several ways.

Since lime can be successfully burned here, chlorine may be used with it in the manufacture of bleaching powder ("chloride of lime"). The city of Manila uses over 100 kilograms of the latter per day in the purification of the city water supply alone. Sodium hypochlorite, which is well adapted for bleaching native hats, can be readily prepared from bleaching powder and sodium carbonate.

For many years the Bureau of Science has been interested in securing a local denaturing material for alcohol. The chief ob-

jections to denatured alcohol are the expense of the denaturing material and the fact that many denaturants are injurious to the metal parts of the engine, when it is used as fuel. Years ago the Bureau of Science studied macabuhay and many other possible local materials, but they all proved infeasible on account of the ease with which alcohol could be separated. There would be more chlorine from the manufacture of caustic soda than could be advantageously used in the bleaching powder industry. Since alcohol is and lime can be produced locally, the excess chlorine can be used in conjunction with the same for the manufacture of crude organic solvents of which chloroform can be satisfactorily used in denaturing alcohol for many purposes. The manufacture of chloroform can be effected by the direct action of bleaching powder upon ethyl alcohol, or first by the chlorination of ethyl alcohol to produce chloral, which in turn is allowed to react with lime, and in other ways.

In lime, salt, caustic soda, bleaching powder, and chloroform there is a group of allied industries that should be successfully operated together in the Philippine Islands and that present an excellent opportunity. It is believed that the cost of transportation would amply protect the local manufacturer from foreign competition.

Water field survey.—The Bureau of Science has continued its interest and work on an investigation of Philippine water supplies. A large amount of time has been devoted to the examination of water from various sources with a view to determine their availability for use as municipal supplies and for boiler use. Although the question of industrial supplies has as yet assumed no great importance in the Philippines, it will surely become more and more important each year. Considerable attention has been, therefore, devoted to the industrial application of water, especially with regard to irrigation.

The field survey has been extended in Sorsogon, Negros, Cebu, Misamis, Rizal, Laguna, Nueva Vizcaya, and Mountain Provinces. The work in Negros has especially given good results and has resulted in the following Provincial Order:

THE PROVINCIAL GOVERNMENT OF OCCIDENTAL NEGROS,
OFFICE OF THE DISTRICT HEALTH OFFICER,
BACOLOD, P. I., *February 21, 1917.*

CIRCULAR TO ALL SECTION HEALTH CHIEFS.

Inasmuch as water supplies constitute one of the most important parts of public hygiene, it is requested that every 15 days each section health chief make an examination of the condition of the artesian well pumps installed in the municipalities under his jurisdiction. On the 15th and 30th of each

month, the section health chief should report to this office any pumps out of order and the municipality in which each is located, so that a prompt request for their repair may be sent to the proper authorities to the end that the people of the municipality be not deprived of potable water for a long time.

Taking into consideration the importance of this work in regard to public health, and the little trouble required to make an examination of the condition of the pumps, it is hoped that the section health chiefs will take an especial interest in it in order that the numerous diseases that have their origin from contaminated waters may be avoided.

(Sgd.) D. MONTINOLA,
District Health Officer,
Occidental Negros, P. I.[1]

The work in northern Luzon has been of special interest because it has greatly increased our knowledge of the water of this geologically interesting region, furnished data of value in connection with the study of radioactivity, and demonstrated the applicability of the Bureau of Science field methods and apparatus under the very severe conditions imposed by the difficulties of travel in the mountains.

The publications of the Bureau of Science on the subject of water to the present time are as follows:

Edwards, R. T. A biological study of the water supply of the Philippine Islands, with a description of a new pathogenic organism. *Phil. Journ. Sci., Sec. B* (1908), **3**, 121–130.

Editorial: Discussion of the paper by Dr. Edwards. *Phil. Journ. Sci., Sec. B* (1908), **3**, 187–188.

Adams, G. I. Medical survey of the town of Taytay. II. Geology and water supply. *Phil. Journ. Sci., Sec. B* (1909), **4**, 211–214.

Clegg, M. T. Medical survey of the town of Taytay. III. Bacteriological analyses of the water supply. *Phil. Journ. Sci., Sec. B* (1909), **4**, 215–216.

Richmond, G. F., and Gana, V. Q. Medical survey of the town of Taytay. IV. Chemical analyses of Taytay waters. *Phil. Journ. Sci., Sec. B* (1909), **4**, 217–218.

Walker, E. L. A comparative study of the amœbæ in the Manila water supply, in the intestinal tract of healthy persons, and in amœbic dysentery. *Phil. Journ. Sci., Sec. B* (1911), **6**, 259–280.

Cox, A. J., Heise, G. W., and Gana, V. Q. Water supplies in the Philippine Islands. *Phil. Journ. Sci., Sec. A* (1914), **9**, 273–412.

Heise, G. W. Water supply for the city of Iloilo. *Phil. Journ. Sci., Sec. A* (1915), **10**, 65–74.

Heise, G. W. Water supplies in the Philippine Islands, II. *Phil Journ. Sci., Sec. A* (1915), **10**, 135–170.

Pratt, W. E. The location of artesian wells in the Philippine Islands from a geologic viewpoint. *Phil. Journ. Sci., Sec. A* (1915), **10**, 231–240.

Heise, George W. Notes on the water supply of the city of Manila. *Phil. Journ. Sci., Sec. A* (1916), **11**, 1–14.

[1] Translated from the Spanish.

Heise, George W., and Aguilar, R. H. The oxygen-consuming power of natural waters. *Phil. Journ. Sci., Sec. A* (1916), 11, 37–48.
Wright, J. R., and Heise, George W. The radioactivity of Philippine waters. *Phil. Journ. Sci., Sec. A* (1917), 12, 145–165.

Furthermore there is now in press a monograph entitled Philippine Water Supplies, which gives the most important features of the work together with data of general interest necessary for the comprehension of water-supply problems. The chapters are:

I. The improvement of Philippine water supplies.
II. Water for domestic use.
III. Storage and distribution of water.
IV. Purification of waters.
V. Water for industrial purposes.
VI. Mineral waters.
VII. Bottled natural and mineral waters.
VIII. Radioactivity of Philippine waters.
IX. Quality of Philippine waters.
X. Methods of water examination.
XI. Interpretation of water analyses.
XII. Appendices.

The war has emphasized the necessity of water analysis and sterilization of water in the field. As field work has formed an important part of the recent work of the Bureau of Science on water supplies, field methods are discussed at length. There are included not only the results of field work, but also the methods now in use by the Bureau of Science. The work as it stands should be of interest not only to the Philippine Health Service and other branches of the Government interested in sanitation problems, such as the Philippine National Guard, but also to manufacturers and private individuals. The methods of analysis are extremely applicable to camp-sanitation problems and should find application in sanitary engineering work. It may be noted that the local United States Army medical authorities have shown great interest in our work. A group of about twelve officers of the Medical Corps, including Col. F. A. Winter, came to this laboratory for information regarding our methods. At the present time, Lieut. H. G. Maul is studying the possibilities of field methods with a view to their adoption for the purposes of the Philippine National Guard.

Radioactivity.—Work on radioactivity has been continued. A study of the radioactivity of Sibul Springs has shown that there is surprisingly little variation throughout the year. In the course of the study in northern Luzon several highly radioactive springs were found, notably in the neighborhood of

Kiangan, Ifugao. It is of interest that radioactive waters are rather scarce in northern Luzon and that most of those discovered are located in a comparatively small section of Ifugao.

With the coöperation of Dr. James R. Wright a study has been made on the radioactivity of sea water. The radioactivity of the waters of the China Sea is much lower than that of any ocean water yet reported. This study was made by an improved method devised by Doctor Wright, which enables measurements to be made on a much larger quantity of water than is generally employed in such work, so that it is believed that greater accuracy has been achieved than is ordinarily the case. In this connection attention is invited to the radium imported into the Philippine Islands for therapeutic work as described on page 23.

Mineral springs.—In answer to a request from the American Woman's League for information regarding Philippine mineral springs accessible from Manila, the following was given:

At *Los Baños*, Laguna, there are a number of hot springs giving pure, highly mineralized water. It is classified as a thermal, saline, silicated calcic bicarbonated water. Los Baños is easily accessible from Manila by automobile, train, or boat. The trip is pleasant, and excellent accommodations are available.

Sibul springs are easily reached from Manila by automobile or by train (the last 10 kilometers are covered by automobile or carromata). Good accommodations may be secured. The Government has erected a beautiful concrete bathhouse at the springs. The waters are very pure bacteriologically. They are nonthermal, not heavily mineralized, calcic, bicarbonated. sulphuretted.

Pansol is a barrio of Calamba, very near Los Baños, on the Manila South road and on the railroad. Here is a series of hot and cold springs issuing from a very beautiful grotto in a cliff of red, volcanic basalt. The springs form a large pool of clear, hot water, making a delightful bath. There are no bathhouses or accommodations for visitors at Pansol, but the accessibility of the springs, their nearness to Los Baños, and the beauty of the surroundings make them well worth a visit. The waters are moderately mineralized, thermal, alkaline, bicarbonated.

The well-known *Bumbungan* spring is situated at Pagsanjan, Laguna, on the river bank, very near the jaws of the beautiful Pagsanjan gorge. A bathhouse dating back to Spanish times has been built. The water is nonthermal and only very mildly mineralized. The country in the vicinity of Pagsanjan is very beautiful. It is accessible by train, by boat, and, at certain seasons of the year, by automobile. Accommodations for small parties are good.

Pakil, Laguna, is somewhat out of the beaten path, and there are no accommodations for visitors, yet it is comparatively easy of access and well worth while because of its picturesque surroundings. It is easily reached by boat from Santa Cruz, Laguna, with return to Santa Cruz (or Pagsanjan) possible the same day. The towns on the shore of Laguna

are very picturesque. The spring issues from a cliff and fills a large pool. The water is cool and only slightly mineralized.

There is a large artesian well at *Marilao*, Bulacan, which stands very high in popular regard. It is not far from Manila, on the Manila North Road and on the railroad, so that a trip to Marilao and return can be made the same day. It is on the road to Sibul Springs. A public bath-house has been erected. The water is pure and cool, but only slightly mineralized.

A series of fine hot springs, known as *Klondike* springs, are located on the Benguet Road, only a short distance above Camp One. Good concrete baths have been built. Until a short time ago, good accommodations could be secured at the springs. The waters are very hot, saline, calcic, sulphated.

There are a number of springs in Mountain Province, many of which, however, are not readily accessible. Among these, the hot springs at *Itogon* are worthy of mention, because of the beautiful country in which they are located, and because the trip, preferably on horseback, from Baguio to Itogon and return can easily be made in a day. The springs are located in a river bed and at present are not cared for. There are no baths or accommodations for visitors.

The sources on the list have reputations for medicinal virtues and are readily accessible, or are situated in localities of sufficient beauty to make a visit to them worth while. Some of the sources noted are radioactive and may be of special value for this reason.

Recently the Bureau of Science has carried on surveys and collected data by means of *questionnaires* with regard to (1) medicinal and poisonous plants, (2) birds, and (3) fishes, and I am of the opinion that valuable information may be acquired in the same way with regard to springs, wells, etc. Such data would contain misinformation and errors, but would supply a list of known water sources at practically no cost that would serve as a basis for future study in connection with our field work.

Water purification.—The method devised by the Bureau of Science for sterilizing demijohns is now in operation in two of the largest water companies and appears to be giving satisfactory results. A report on the comparative value of chloramine and hypochlorite as water disinfectants was made. This report shows that in the laboratory for a period of five days chloramine is considerably less efficient for disinfecting the Manila city supply than is hypochlorite.

An examination was carried on with Pasig River water, which is known to be contaminated with factory effluents and other wastes and occasionally flows with great velocity, which shows the inadvisability, on account of its easily corroding action on material such as limestone. of using limestone on the face of the Jones bridge below the water line.

Clays and clay products.—Preliminary experiments have shown that Philippine clays and shales are suitable materials for many uses. Many samples of clay have been passed upon as to their suitability as pigments, raw cement materials, and for the manufacture of vitrified and common bricks, tiles for roofing and flooring, for making pots, clay stoves, and other pottery products, etc. Advice has been given as to whether the soft- or stiff-mud process should be used in molding common bricks, as to the type of kiln that would be most satisfactory for burning, etc. The Bureau of Science has also made molds for, and given technical advice to, kiln operators and to the Philippine Health Service, in order to develop the industry of the manufacture of vitrified clay pipe for the system of toilets that the Health Service is endeavoring to introduce into the towns of the Islands. A pottery kiln is now under construction and nearly completed in order to make fire tests on a larger scale. The manufacture of tile sufficiently light to substitute nipa and galvanized iron for roofing purposes is being contemplated, and the experiments in this direction have been already started.

Concrete deterioration.—At my request the United States Army Engineers were kind enough to make concrete cubes for exposure tests of each mixture that entered into the construction of Quartermaster Pier 1. Seven lots of cubes were manufactured between November 24, 1913, and October 22, 1914. All the cubes were kept damp until June, 1915, when they were exposed to weather until July 6, 1915, at which time the set from each mixture was divided, one portion being placed in a cage and submerged in Manila Bay under Pier 1, and the duplicate specimens being exposed in the open to the weather on the grounds of the Bureau of Science. On August 28, 1917, the cage was raised, and a sample cube from each mixture was removed for testing with its duplicate, which had been subjected to weather exposure. In each case the results showed a very much lower compressive strength for the sample that had been exposed to sea water. The decrease in ultimate compressive strength averaged over 24 per cent. The cage was returned to its position under Pier 1, where it will remain for a similar continuation of this test a few years hence.

Samples of concrete have been collected from Philippine structures that have failed, in an effort to determine the cause of failures and to formulate from the results obtained methods by which such deterioration may be avoided. The results in most cases seem to indicate that the aggregate, especially the

sand, is the cause. In some cases there is a suggestion that the failure was possibly due to the use of salt or brackish water. A study is now being carried on to determine the effect of different percentages of clay on the tensile and compressive strengths and the durability of sand mortars and concrete when exposed to fresh and sea water.

Course in cement testing.—The Bureau of Science has continued to give the course in Cement Testing Laboratory Civil Engineering 2 of the University of the Philippines.

Soil.—Bureau of Science Press Bulletin 64 on Directions for Taking Soil Samples has been much in demand. Since the principles of these directions with regard to selection of locality, union and quartering of samples, etc., have been followed more in detail, the samples arriving at the Bureau of Science have been much improved. The Bureau of Science has been able to give a great deal of advice with regard to the composition of soils and the differentiation of soils suitable for sugar cane, rice, coconuts, hemp, tobacco, etc., having principal reference to the quality and fertility of the soil and the climatic conditions that are encountered, that would demonstrate the agricultural possibilities of the various provinces of the Philippine Islands.

Fertilizer tests with molasses.—A large amount of work has been done in other countries with regard to the fertilizing value of final cane-sugar molasses, but it is believed that certain experiments should be tried in actual growing tests. The experiments of the Bureau of Science indicate that a carrier may be provided for waste molasses that will enable its direct use as a fertilizer without the production of a sour soil.

Sugar work.—The Bureau of Science has been able to give much assistance and instruction with regard to the operation of smaller plants in Luzon as well as in Negros. Two polariscopes belonging to the Bureau of Science were destroyed by fire when its Iloilo laboratory was burned two years ago. A standing order since that time has not yet been filled. Planters and others are much handicapped by the impossibility of obtaining polariscopes at the present time. The Bureau of Science has been of great assistance to many sugar men in inspecting and repairing such polariscopes as are available for their plantations and mills. The sugar chemist spent three months in Manila and on Luzon Island in order to further the sugar industry in this part of the Archipelago. He was able to advise planters to a considerable extent. The Bureau of Science is giving considerable help to some sugar centrals in determining the true cause of the low yield of sugar from cane. In some

cases the trouble is entirely mechanical, for the units are not properly set nor coördinated and the tubes of the triple effect and other units are not protected from corrosion and scale. It is most necessary always to have intelligent mechanics in charge of a plant. The Bureau of Science is completing the installation of an experimental laboratory unit for demonstrating new methods of working up juices and of producing strikes from sirups.

Nipa sugar.—During the year an article entitled Nipa as a Commercial Source of Sugar was translated into Spanish and printed as Bureau of Science Press Bulletin 67.

Castor oil.—The preparation that is now being made by the United States in the development of an aëroplane service will call for enormous quantities of castor oil, 3,785,430 liters (1,000,000 gallons) being the estimated need for 1918. The castor-oil plant (tañgan tañgan) grows wild throughout the Philippine Islands, and it is only necessary to pay a sufficient price to induce the people to gather the seeds from vacant lots and waste places. The cultivation of the castor-oil plant must be greatly extended to meet this need, and there is no reason why the Philippine Islands should not supply a large part of this oil. The plant will begin to produce seeds in about four or five months from the time of planting and will continue to yield them for several years thereafter. The wild variety has small seeds with a fair percentage of oil, but it cannot be expected to yield such large returns of either seeds or oil as the domesticated Indian forms. The Bureau of Science has just investigated samples of native and of the domestic Indian variety of castor beans under cultivation in the Philippine Islands. The Indian seeds average about 52 per cent of oil, whereas the native seeds contain only about 40 per cent. The Philippine Government has imported Indian seeds of the better varieties of castor beans (*Ricinus communis*).

Leather industry.—The Bureau of Science has continued its assistance to tanners. After a careful investigation of conditions prevailing in local tanneries, a chemist of the Bureau of Science has succeeded in preventing the putrefaction of sole leathers, thus rendering a valuable service to local tanners.

Control of Manila city gas.—The Bureau of Science is making for the city of Manila daily tests, calorific value, purity tests, etc., of the gas now being manufactured by the Manila Gas Corporation, in order to afford the necessary means to protect and safeguard one of the public interests.

The importance of the control work in connection with the

manufacture of gas supplied to the public may be well illustrated by quoting one of the requirements under the City Ordinance. Section 10 of Ordinance No. 214 reads: "Heating power of Gas—(*a*) The heating value of the gas sold and supplied to consumers by the corporation shall at no time be less than five thousand (5,000) French calories for one cubic meter of gas." The density of a gas varies according to the temperature and pressure, and in most countries many meters may be in warmer and others in cooler locations, but an effort is always made to use those conditions for gas tests that approach as nearly as possible the average annual temperature and pressure. In the United States 60° F. (15.6° C.) fairly represents the average temperature at which a gas is metered to the customer. The Bureau of Standards, Washington, D. C., states: "On the average the meter temperatures are so near to 60° F. that one would not know whether to raise or lower this figure if a change were to be made." In the Philippines there is very little seasonal variation in the temperature and very little approximating has to be done. Twenty-seven degrees centigrade approaches as nearly as possible the average annual temperature and is the one at which gas is measured to customers in Manila. With no control work the gas manufactured can be considerably lower than the standard, without this condition being detected, which will entail loss to the public. Supposing that the daily consumption of gas is 10,000 cubic meters, and its price is 9 centavos per cubic meter, a decrease of 5 per cent from the standard will mean an annual loss to the consumers of ₱16,425; and of 10 per cent, a loss of ₱32,850. On the other hand, an increase from the standard might also mean a loss. The burners are set for a gas of a given quality, and for a richer gas there might be incomplete combustion and, therefore, no more heat effect than from a gas that is below standard.

Weights and measures.—The certification of standards of sets of weights and measures for the provinces and municipalities has continued. Only those weights with sufficient accuracy to be acceptable as standards are marked with the Bureau of Science monogram or are assigned a number. A careful record is kept in case the weights are later returned for restandardization. No weights are allowed to pass from the Bureau of Science unless they are sufficiently accurate to be used as secondary standards without correction.

Iron.—Owing to the war and the greatly increased cost of iron, old and scrap castings have been remelted in Manila. In some cases the melt was "a whitish iron tremendously hard and

very brittle." The Bureau of Science was able to give assistance to remedy the trouble.

Corrosion.—In the Philippines, where humidity and temperature so much accelerate ordinary corrosion, this problem assumes even more than ordinary importance and has received considerable study by the Bureau of Science. During the year an investigation of the corrosion of iron in sulphuric acid has been completed, except for the interpretation of certain complicating factors. The results of this study will throw considerable light on the general problem of corrosion. The Bureau of Science has been able to give assistance in many cases where corrosion was doing much damage. The rapid deterioration of certain locomotive boilers in use by the Manila Railroad was a subject of intensive study and gave interesting results. The excessive corrosion noted on copper water tubes used was shown to be due to thermal electromotive forces as well as to contact potentials of dissimilar metals. Recommendations with regard to altering the design of future boilers for the Manila Railroad Company were given that will obviate the difficulty.

Paint.—The study of paints has been continued, and excellent progress has been made although less rapidly than last year. The first portion of the work on the comparison of linseed and the lumbang oils has been completed. The results thus far obtained demonstrate that the lumbang oils are valuable and efficient paint vehicles, comparable in many respects with linseed oil. They have exceptionally good moisture-excluding properties. Work has been done not only on the separate oils, but on their combinations with each other and with linseed oil. The interesting fact has been brought out that certain combinations are more desirable for certain purposes than any of the separate oils. So far only one pigment, red lead, has been employed, but the work is to be continued to include others. The results of this work should stimulate the extraction of lumbang oil.

Nipa dye.—Some work was done on the subject of fireproofing nipa, but the results of preliminary work were not found sufficiently promising to warrant more detailed study because of the brittleness of the resulting product. However, the extract of nipa was found to contain an interesting and valuable coloring matter suitable for leather, wood, and perhaps for other products, and its study will be continued.

Daluro stoppers.—A satisfactory substitute for cork stoppers for alcohol demijohns has been made by impregnating pagatpat (daluro) with a low melting point paraffin.

Bast fibers.—Bast fiber is the tough fibrous layer between the wood and the bark that is characteristic of certain families of plants, some of which are represented in the Philippine Islands by numerous species. These bast fibers have an extensive local use as a substitute for abacá, and in some parts of the Islands, for example, in the Iloco provinces, the making of rope from bast fiber has considerable commercial importance. Some bast-fiber ropes are superior in durability to abacá rope when much exposed to moisture. A thorough study of the physical properties of these fibers is being made by the Bureau of Science, which will encourage cultivation and the development of the manufacture on a commercial scale of those fibers that prove to have sufficient strength and durability for cordage purposes.

Rubber.—The plantation-rubber industry in the Orient has had a most remarkable development during the last few years. The India Rubber World states that in Malaya alone the area of about 15,400 hectares (38,000 acres) in 1905 had increased to 271,000 hectares (670,000 acres) in 1915. The development of the industry has proceeded very rapidly in British North Borneo, Ceylon, Sumatra, and elsewhere. The imports of crude rubber into the United States for the fiscal year ending June 30, 1917, are reported as 151,533,505 kilograms (333,373,711 pounds), valued at ₱378,657,348. The United States is the world's greatest consumer of crude rubber; and the development of a source of supply within her own jurisdiction, where it will be free from the danger of prohibitive foreign export duties or possible embargoes, is most desirable.

In the Philippines some rubber is now produced. The Basilan rubber plantation was started in 1905 and the first Pará rubber (*Hevea brasiliensis*) was planted in 1907. There are now 80 hectares (200 acres) of rubber trees less than 2 years old and 136 hectares (340 acres) of trees varying in age from 3 to 10 years. In 1916 there were 20,510 trees in tapping, giving a total yield of 14,954 kilograms of dry rubber, or an average yield of about 0.73 kilogram (1.6 pounds) per tree, which is very satisfactory when it is considered that half of the trees first came into tapping only two years ago. The cost of production is not excessive, and as the trees become older and the yield increases, it should be possible to lower this considerably. Another estate on Basilan Island now has a few trees coming into tapping, and land is being cleared for a third plantation. There is also a small plantation of Pará rubber on Cotabato River and one of Castilloa rubber in the Davao district, Mindanao.

Climatic conditions in the southern Philippine Islands com-

pare favorably with those of other rubber districts and seem admirably suited for the growth of Pará rubber. Records of rainfall kept on the Basilan plantation since 1912 show it to be uniformly distributed and that there were only three months in the five years when it was less than 25 millimeters. The records from other stations in Mindanao indicate localities possessing suitable climatic conditions for rubber. The record of growth and yields of Pará rubber trees on Basilan Island and conditions such as temperature and freedom from strong winds compare favorably with similar conditions in countries where rubber is now being successfully cultivated. The studies of the Bureau of Science show that rubber in the Philippine Islands is at present comparatively free from fungous and other diseases, and most of those so destructive to rubber in other countries have not yet been found in the Philippines. However, planters should be on the lookout for fungous diseases, and should any appear, the necessary measures for their control should be applied before they have secured a foothold and caused serious loss. The future for the rubber industry in the Philippine Islands appears to be very bright.

Timber testing.—There has been a great demand from the City Engineer and many sources for tests of Philippine timbers. This work is now underway. At first the work will be confined chiefly to apitong and tangili, but such results on other common timbers, such as the lauans, the yacals, guijo, lumbayao, etc., as is possible will be secured. It is hoped that the data of the tests may indicate the suitability of Philippine timbers for use in the construction of wooden ships. An attachment to the testing machine has been made to accommodate logs to a maximum length of 5 meters.

Anay exterminator.—The Bureau of Science anay (termite) exterminator is prepared in the following manner:

> To a 5-gallon can of kerosene is added about 100 cubic centimeters of saturated solution of white arsenic in hydrochloric acid (about 1 volume of acid to 1 of water); the can is then tilted so that the arsenic solution stands in the bottom at one corner, and about 50 cubic centimeters of concentrated sulphuric acid are added. The result is the withdrawal of water from the hydrochloric acid and the saturation of the kerosene with hydrochloric acid gas containing arsenic trichloride.
>
> The process of making this solution is very *dangerous*, and it should be performed only in the open by a person fully aware of the great precautions to be taken and the necessity of avoiding any accidental inhalation of the fumes produced. The process is complete after the reaction has stopped, and the solution is ready for use.

The success of this solution depends largely on the way it is

applied. The application can be made by painting it on the surface of the wood or spraying it with a common foot pump. The parts that are not accessible should be first exposed; if this is not possible, a pump should be used to force the solution in to all parts of the wood that are liable to be attacked by anay. Some success may be had by injecting it into the affected parts. The mixture may be also effectively used in killing beetles that bore freely into bamboo and soft woods, if it is applied in the same way as for anay.

This solution will corrode kerosene cans very rapidly and will eat its way through in a few days. It can be satisfactorily kept for some time in an ordinary glass demijohn.

Copra drying.—The many coconut-oil expellers and presses now installed or in negotiation are probably more than enough actually to handle the copra output of the Philippine Islands. Therefore there will be competition for copra, and probably very soon there will be marked difference in price between the various grades, thus giving an incentive to produce copra of good quality and an impetus to the Bureau of Science method for drying coconut meat. The method referred to is exceedingly simple and consists briefly in putting the opened nuts on trays and subjecting them in a closed space to the fumes of burning sulphur (sulphur dioxide, sulphuric acid anhydride). After this treatment the nuts are put under a shed or in the sun to dry, the completion of which requires four or more days according to atmospheric conditions. The only apparatus required is a wooden box of proper size, a few trays, and a 4-wheeled car mounted on a wooden track. Details and a photograph giving all dimensions of the equipment may be obtained from the Bureau of Science on application. Such treatment will greatly improve the product. Not only is the keeping quality of the copra improved, but the action of the sulphur fumes is to kill all mold spores, thus preventing the growth of molds during the drying process, to soften the cell walls of the coconut meat so that the moisture comes out readily, and to make an exceptionally white and uniform product. There is no loss of oil during the process, and a greater weight of copra is obtained, for no oil is destroyed by growing organisms. The oil produced from copra of this kind is practically colorless, is free from rancidity, and is pronounced equal to, or even better than, the best Cochin oil. Coconuts opened and treated with sulphur fumes at the Bureau of Science in the midst of a severe rainstorm and that subsequently received no artificial drying or exposure to sunshine remained perfectly white until dry. A commercial trial of the

Bureau of Science process during a typhoon showed that copra of good quality could be produced. The growing of coconuts is one of the most promising industries in the Philippine Islands.

Fuels.—Samples of coal are continually brought to the Bureau of Science by prospectors from new districts for analysis and valuation. A great deal of advice has been given with regard to prospecting, development work, the operation of Act No. 2719 to provide for the leasing and development of coal lands in the Philippine Islands, etc. In order to encourage prospecting in new districts of which the Bureau of Science has no record, an analysis of the first sample of each variety of coal is made free of charge, provided that it is accompanied by reliable detailed information. There have been several requests for steaming tests. Owing to the difficulty of transportation it has been impossible to send the necessary quantity of some varieties of coal to the laboratory. Producer-gas tests have been made, and the plant has been operated efficiently on several varieties of coal. Where a producer-gas plant is impracticable, the firing of pulverized Philippine coal by means of special equipment seems feasible. Recent investigations made by railway and engineering companies of the United States have shown that pulverized lignite or bituminous coal can be advantageously fired in locomotives and under stationary boilers. Among the advantages reported are a saving of from 20 to 40 per cent over firing the fuel in any other way and an increase in boiler efficiency of from 10 to 15 per cent. Producer-gas tests also have been made on refuse lumber, a mixture of lumber and sawdust, bagasse, coconut shells, a mixture of coconut shells and husks, and copra meal. The importance of the last two as fuel warrants separate discussion, and I have included them as follows:

Copra meal as fuel.—There is a large quantity of coconut meal now in the Philippine Islands for which no transportation is available to take it to market. Experiments have been carried on with it as fuel in the Bureau of Science producer-gas plant and under one of its Babcock and Wilcox boilers, which has an elongated fire box.

The Bureau of Science operates a 67-horsepower Otto suction producer-gas plant designed especially for low-grade Philippine coal. The plant consists of a producer and its auxiliaries and a gas engine direct coupled to a 50-kilowatt dynamo. It has worked efficiently on copra meal and other fuels. Copra meal has an available heating value of 3,855 calories. The results of a ten-hour test in the producer-gas plant, where an average of 100 kilograms of fuel per hour was used, show a consumption

of 3.22 kilograms of copra meal per net kilowatt hour. The best record for Fushan coal in the producer-gas plant shows a consumption of 1.28 kilograms of fuel per net kilowatt hour, and the consumption of average coal as fired under a Bureau of Science Babcock and Wilcox boiler unit for the production of electric current shows a consumption of over 3 kilograms of coal per net kilowatt hour.

Coconut meal has been also advantageously fired under the Bureau of Science boilers. In an external or elongated fire box copra meal burns excellently and efficiently without the admixture of any coal provided it is fired in small quantities at very short intervals. If copra meal were burned in a furnace provided with a mechanical stoker, and having a grate similar in design to the type used in burning rice husks, the loss of heat due to opening the furnace door for firing would be obviated and a still higher efficiency obtained. For fuel purposes a ton of copra meal is equivalent to about 0.6 ton of ordinary (Tagawa) coal.

The ash resulting from the combustion of copra meal is very valuable on account of its potash (K_2O), and wherever copra cake is burned the ash should be saved. Potash is a fertilizer ingredient of which the original copra meal contains 2 per cent. All of this may be recovered in the ash unless a portion is volatilized. In the boiler plant the quantity of ashes collected from the pit is relatively small due to the amount of powdered fuel and ashes carried over the bridge wall. Any deposit that collects on the boiler tubes may be easily blown off.

Coconut shells and husks.—The Bureau of Science has received a great many inquiries with regard to uses for coconut shells and husks. Experiments have been carried on in the Bureau of Science that demonstrate their usefulness for fuel and other purposes. Tests of a machine for producing fiber from husks have been completed. As yet no machine seems to have a great advantage over the hand method.

The fuel value of air-dried coconut shells and husks is shown by the following data:

		Shell.	Husk.
Moisture	per cent	11.75	14.71
Available calories		4,060	3,781
Total calories		1,528	4,197

The most economical use of coconut shells as fuel is in a properly designed producer-gas plant. In the producer-gas plant of

the Bureau of Science described under "Copra meal as fuel" tests have been made that have shown that about 3 kilograms of shells (that from ten coconuts) are required to develop one kilowatt hour at the switchboard. This efficiency probably can be increased as more experience is acquired in burning them. One kilogram of coconut shells is equal in calorific value to about 0.65 kilogram of Japanese coal. However, in comparing the value of two fuels, the factors of the cubical measure of a given weight as it influences the expense of transportation and marketing and whether or not the furnace is adapted to the use of the particular fuel are especially important. Coconut husks are so bulky that they can scarcely compete with coal as fuel for boiler furnaces, unless it is feasible to bale them so as to reduce their volume.

The complete results of the investigation on the use of coconut shells and husks as fuel and on the possibility of establishing the coir industry in the Philippine Islands will be soon published.

Wood fuel.—During the year the Bureau of Science has received many inquiries with regard to the briquetting and use of sawdust for fuel and with regard to the use and possibilities of cord wood and shorter lengths. Sawdust and chips can be used satisfactorily in a producer-gas plant as pointed out under "Fuels."

The use of firewood should be increased. For domestic purposes it is cleaner to handle, and there is not the waste as in run-of-mine coal, where a considerable percentage of the slack falls through the grate. In the vicinity of all large Philippine towns there is ample vacant land on which rapid-growing trees could be planted for domestic firewood. Ipel-ipel [*Leucaena glauca* (L.) Benth.] grows rapidly on almost any soil, and the seeds can be broadcasted.

The handling of wood is somewhat more expensive than the handling of coal. More storage space is necessary for wood than for an equivalent available heating value of coal, and in boiler plants more frequent cleaning is necessary to dispose of the fine ash and other products that are carried over the bridge walls. Many boiler units are designed for a special variety of coal and can, therefore, burn wood less efficiently.

The total available heating value of the combustible portion of all dry woods is approximately the same, and in similar woods the variation in the ash content is, in general, of comparatively

small importance. Therefore the two most important factors controlling the value of wood for fuel are the content of moisture and the specific gravity. The best-seasoned wood in a Philippine climate will retain an approximately uniform amount of moisture. Hence for air-dried wood its compactness is practically a direct function of its specific gravity, and it is only necessary to know its specific gravity to determine its fuel value. In general, woods of low specific gravity kindle easily and flash up quickly and the fire spreads rapidly, while those of high specific gravity behave in the opposite manner.

The available heating value of well-seasoned wood is about 3,680 calories, the specific gravity of well-seasoned mangrove wood (Rhizophoraceæ) is about 0.9, and there are generally 35 per cent of voids, or interstices, in wood of a meter or more in length. The available heating value of average imported coal is approximately 6,500 calories. From the above numbers it may be computed that, in general, a ton of coal is theoretically equivalent to 3 cubic meters of air-dry Philippine mangrove wood. However, various consumers report the use in actual practice of one and one-third or more cords of wood in lieu of 1 ton of coal.

General.—A large number of other investigations and short experiments necessary in solving various problems of commercial and sanitary importance are being carried on and are in various stages of completion. Coöperation with the section of botany is mentioned on page 32. As much laboratory technical work has been accomplished in the various lines of chemistry as the pressure of more urgent work would permit. However, it must be realized and remembered that in spite of the fact that technical research is necessary for the proper economic development of the country with the present shortage in personnel little time can be devoted to such work in the future unless more men are available or unless a marked decrease in the amount of routine work takes place.

Publications.—The Director of the Bureau of Science contributed a paper entitled Philippine Fuels, which was published in the 1917 Christmas number of the Cablenews-American. See page 77. The article discussed the coal, wood, coconut shell and husk, copra meal, crude petroleum, and industrial alcohol situation in the Philippine Islands. Other topics upon which articles have been published are included under the heading Philippine Journal of Science, Section A, on page 72.

DIVISION OF GENERAL, INORGANIC, AND PHYSICAL CHEMISTRY

The personnel of this division has undergone considerable change. The chief of the section of physical and mechanical testing, Dr. J. C. Witt, and Mr. Francisco Peña resigned effective August 13, and November 30, 1917, respectively. Several additional scientific assistants have been appointed. The chief of the section of weights, measures, water analysis, and physical chemistry has been on leave since August 20, 1917. On the same date Mr. A. S. Behrman departed on leave of absence to visit the United States. Mr. Francisco D. Reyes was assigned to the Bureau of Science Iloilo sugar laboratory on November 3, 1917. The assay work was transferred to the section of analytical chemistry on April 27, 1917. There has been the closest coöperation between the men of this division, and the one in charge of one section with the assistance of the older men in others has supervised the work when the chief of another section was absent. In spite of the present shortage of personnel caused by resignations, assignment to other duties, and other unavoidable conditions and on account of the ability, willingness, and spirit of coöperation of the men in this division, who have often worked overtime and on holidays to keep up with the work, the division has been able to perform in a very satisfactory manner all of the routine work requested by the other branches of the Government, commercial houses, and private parties.

Routine.—The routine accomplished by the division of general, inorganic, and physical chemistry has been very great, and the amount is shown in the following general summary:

Nature of material.	Samples.
Rocks and minerals	129
Soils, fertilizers, cements, and clays	5,508
Metals and alloys	8
Road materials, stone, gravel, sand, and concrete	277
Water	215
Calorimeter determinations of fuels	13
Standardization of weights and measures	1,126
Coal analyses	20
Paint	5
Miscellaneous	158
Fire assay of gold and silver	368

In connection with the purely routine work, members of the division of general, inorganic, and physical chemistry have been frequently called upon to pass judgment on the quality and commercial value of samples submitted for analysis.

Under date of October 20, 1917, I received the following letter from the Director of Public Works:

I have the honor to advise that cement testing requirements will greatly increase from now on in view of the large public works program in the course of inauguration. It will be impossible to properly prosecute public works unless the Bureau of Science is prepared to double its cement testing activities. It is therefore extremely urgent that you make the necessary representation to the proper authority for such additional help as may enable you to test cement at a rate which will give us an average of 15,000 barrels of cement each month. Please advise whether this Bureau may anticipate this increased activity on the part of the Bureau of Science.

The Bureau of Science has under way preparations such as to enable it to care for this increased work.

The Portland cement specifications of the Philippine Government conform to those of the United States Government [Circular of the Bureau of Standards (1917), No. 33, 3d edition, page 26, paragraph 58] in that "Briquettes that are manifestly faulty, or which give strengths differing more than 15 per cent from the average value of all test pieces made from the same sample and broken at the same period, shall not be considered in determining the tensile strength." The cement-briquette molders of the Bureau of Science are carefully selected, and further, in order to secure the highest quality of output from each successful worker, a system of monthly bonuses for high uniformity is in use and it is now rare that variations are this great. To receive a reward the following are the average maximum variations in pounds permissible in a series of three cement briquettes:

Age.	Neat briquettes.	Mortar briquettes.
7-day	45	25
28-day	55	35

No prize is given when more than 20 per cent of the briquettes exceed the limit by 15 pounds or when any are rejected. The briquette molder making the best record for a given month receives double the earned bonus, if his work is well within the prescribed limits and is considered of sufficient quality. The plan has worked satisfactorily.

For investigations see page 44 et seq.

DIVISION OF ORGANIC CHEMISTRY

Personnel.—Dr. H. C. Brill, chief of the division of organic chemistry, left for the United States on leave, effective June 5, 1917, and since that date Mr. A. H. Wells, chief of the section of foods and drugs, has been acting as chief. The resignation

of Mr. H. O. Parker, chemist, took effect on May 28, 1917. On October 7, 1917, Mr. Rosado resigned from the position of assistant sugar chemist, Bureau of Science Iloilo sugar laboratory; and on September 30 and on December 5, 1917, the respective resignations of Messrs. Armstrong and Thurlow, sugar chemists of the latter laboratory, were effective. At present the work of the Iloilo sugar laboratory is in charge of Mr. F. D. Reyes, who was detailed from the division of general, inorganic, and physical chemistry, Bureau of Science. A scientific assistant has been recently appointed from the University of the Philippines.

Resignations and absence on leave have reduced the number of chemists to the breaking point. In order to maintain the present standard of efficiency and cope with the increased demands for consultations, investigations, and exact and varied routine analyses, the division of organic chemistry must have the services of additional efficient, well-trained, technical chemists with years of practical experience. The great number of resignations has necessitated a most stringent readjustment of routine, and a heavy burden of work has been placed upon the few remaining members of the division. Under these conditions efficiency is being maintained, in spite of the fact that many difficulties presented by the lack of scientific supplies, practically all of which are now being diverted for war purposes, have had to be met.

Routine.—The chief organic chemist is the Bureau of Science representative on the Board of Food and Drug Inspection, which meets bimonthly to render decisions on all questions related to the enforcement of the Food and Drugs Act and amendments. The great increase in the cost of pure-food products would seem to furnish an incentive for their adulteration. The Bureau of Science has maintained a close inspection of foreign and domestic products and by analyses has furnished evidence that has given protection to the public against the use of adulterated foods and beverages that are unfit for human consumption or are injurious to health. The public has been protected against the use of such injurious substances in foods as saccharin, poisonous dyestuffs, arsenic, preservatives, inferior substitutes, ground glass, filth, ptomaines, etc. The sale of injurious or adulterated medicinal preparations and fraudulent therapeutic devices is no longer permitted. All foodstuffs in closed containers must bear the net weight on the outside label. Manufacturers have found it desirable to conform to the laws, and actually violations are

less frequent now than formerly. The large number of consultations that have been held have furnished valuable assistance to those interested. The chemico-legal work of the division in giving expert testimonies, impartial depositions, affidavits, and analyses have been the means for substantiating decisions of the courts. Much commercial work has been done resulting in financial gains to importers and to manufacturers who have requested the work. The Bureau of Science has done something to encourage the rearing of goats for milk. Goats' milk compares favorably with good sterilized natural milk. In all, this division has performed more than 1,800 analyses of a rather complex nature and has inspected more than 5,000 samples for violations of formulas and misbranding acts.

New installations placed in the laboratory for the manufacture of extract of tikitiki have given most satisfactory results, and the demands for the Bureau of Science preparation show a steady increase as shown on page 20. Many practicing physicians and large corporations have repeatedly requested shipments for the treatment of beriberi among their patients and employees. Reports show most satisfactory results from the use of this extract in the treatment of infantile beriberi. The number of bottles of tikitiki extract sold or delivered during the year are as follows:

	Bottles.
To Liga Nacional Filipina para la Protección de la Primera Infancia	8,034
To the general public	234
Total	8,268

Original work.—Although the accuracy and the time required for organic analyses has kept the staff applied closely to requested routine analyses, yet much valuable original investigation has been completed. Such investigation has been aimed solely at an exploitation of Philippine natural resources of an organic nature. Much has been done in investigating the active principles of Philippine medicinal plants, the medicinal properties of many of the oils used in the cure of leprosy, a study of the antineuritic properties of hydrolyzed extracts used in the treatment of beriberi, a study of products from the destructive distillation of Philippine woods, a study of better methods for the manufacture of alcohol from discard molasses, and comprehensive work on the coconut, copra, and coconut-oil industry. For further information concerning investigations see page 44 et seq.

DIVISION OF MINES

Mr. V. E. Lednicky resigned from the position of chief of the division of mines of the Bureau of Science on January 15, 1917, and the connection of Mr. J. P. Goldsberry with the Bureau of Science was severed effective April 30, 1917. Mr. Victoriano Elicaño was appointed a temporary assistant geologist in the Bureau of Science on April 2, 1917, and on May 15, 1917, as the result of having qualified in an examination, was regularly appointed assistant geologist. The force has been so small that it is impossible to carry on all the work. The absolutely necessary work can be probably kept going with three employees if the ranks can be kept full of competent men. The work that one man can do is very small in comparison with what should be done. The Bureau of Science should have well-trained geologists immediately. Examinations in the Philippine Islands and in the United States failed to secure eligibles at the salaries offered.

In spite of the handicap during 1917 of the seriously depleted condition of the staff, an attempt has been made, with the assistance of members of the staff of other divisions of the Bureau of Science, to handle as much as possible of the routine and other work presented. A great deal of interest has been shown in mining by the Legislature. A number of mining engineers have visited the Philippine Islands during the year with the object of investigating the mineral resources of the Archipelago. The very great interest being manifested in mining by the Government, by private mining engineers, and by the public warrants a considerable increase in the geologic personnel; in fact it is impossible to do the work required by the coal-leasing Act until additional men are secured.

The Bureau of Science has been able to render considerable practical assistance to miners with regard to methods of separation of precious metal from quicksilver, the classification and identification of rocks and minerals, the refining of bullions, etc. The geologists are constantly giving advice of a practical nature, furnishing estimates for new projects, making reports for both the operators and the public on special subjects, examining minerals, etc. In studying the mineral resources, the Bureau of Science gives preference to minerals most urgently needed in the Philippine Islands or in the United States, or to such minerals as due to their great demand will bring the greatest remuneration to the Philippines. Many inquiries have been received with regard to molybdenum, manganese, and tungsten, which are important war materials. Information with regard to a large

number of Philippine mineral deposits such as asbestos, gold, copper, iron, manganese, lead, sulphur, fire clay, guano, salt, raw materials for cement and lime, coal, asphalt, petroleum, etc., has been furnished. In October I wrote a statement relating to the development of the mineral resources of the Philippines for publication in the Statesman's Year-Book as follows:

The production of gold of the Philippine Islands was greater in 1916 than ever before in her history. Gold is found in almost all the larger islands and is at present one of the most important of the mineral products. The Araroy District, Masbate, still maintains its lead in the gold production, though Ambos Camarines and Mountain Provinces have been good producers. The production of gold for the calendar year 1913 was valued at 868,362 dollars, for 1914 at 1,174,633 dollars, for 1915 at 1,316,764 dollars, and for 1916 at 1,505,877 dollars. Silver is found alloyed with gold in practically all of the gold deposits. Copper and manganese deposits are known in many provinces. Three thousand tons of manganese ore were mined in Ilocos Norte and shipped to Japan in 1916. A newly discovered vein of galena has been recently opened. Coal is found in many provinces of the Philippine Islands. The high prices demanded for coal in the Archipelago is stimulating development. The valuable iron ore in the districts of Surigao and Bulacan Provinces and on Calambayanga Island is still undeveloped. Iron is produced by a crude smelting process from the Bulacan deposits. Petroleum is known to occur in five provinces, and the districts are worthy of exploration by drilling. Commercial quantities of asphaltic materials exist in Leyte. Molybdenum, tungsten and antimony materials, sulphur, asbestos, magnesite, fire clay, rock salt, corundum, mineral waters, abrasives, gems, and gypsum are included in possible Philippine mineral resources. Bat guano occurs in caves in nearly every province. The Rizal Cement Company has a small modern plant at Binangonan. The local consumption of Portland cement is certain to increase as the country progresses in financial and industrial importance. In Cebu desirable materials occur adjacent to undeveloped coal fields, the fuel from which is suitable for burning cement. The total value of minerals in 1914 was 2,301,695 dollars; in 1915, 2,433,793 dollars; and in 1916, 2,832,130 dollars.

Identification of stratification samples has been continued, and the last one reported was for well 1064, located in Rosario (Barrio San Carlos), Batangas. The well is 335 feet (102 meters) deep; cased, 230 feet (70 meters); and pumps 40 liters per minute at 13 feet (3.9 meters). In order to show what the examination of so many thousands of samples means, I give the following report from this well:

	Feet.
Brown tuffaceous and pebbly clay	0 to 30
Tuffaceous sand and gravel	30 to 40
Gray tuffaceous plastic clay	40 to 50
Yellowish gray tuff	50 to 140
Yellow tuffaceous clay	140 to 170
Dark gray igneous sand	170 to 240
Do	240 to 335

Data of this kind enable one to distinguish the materials that serve as a reservoir for many of the successful artesian wells and give information that will assist in the location of other successful wells. The assay work done in the Bureau of Science was transferred to the supervision of the section of analytical chemistry on April 27, 1917.

The Bureau of Science has not been able to do all the field work requested. During the year geologists have made professional inspections or examinations of the Mancayan-Suyoc and Baguio mining districts; of some of the gold, asphalt, and petroleum regions of Leyte and Surigao; of certain coal deposits in Negros; and of the gravel supply of San Juan River. The last was found to be all tuffaceous and of too low grade for exploitation.

Much interest in legislation concerning mining has been shown during the year; this subject is discussed on page 19. The Director of the Bureau of Science served as chairman of a committee to draft rules and regulations for carrying out and accomplishing the purposes of Act No. 2719 to provide for the leasing and development of coal lands in the Philippine Islands.

Papers relating to the geology of the Philippine Islands are published in the Philippine Journal of Science. The Mineral Resources of the Philippine Islands for 1916, which has been printed during the year, contains the following articles:

Staff, division of mines, Bureau of Science.
Introduction, by Alvin J. Cox.
Statistics of mineral production in the Philippine Islands for the year 1916, by Victoriano Elicaño.
Metal mining in the Philippine Islands, by V. E. Lednicky.
Coal mining possibilities in the Philippine Islands, by V. E. Lednicky.
The manufacture of roofing tiles. Bureau of Science Press Bulletin 70.
Rizal cement plant, by J. C. Witt.

In spite of the unsatisfactory conditions throughout the world there has been wide, general interest in Philippine mining.

MUSEUM

The ethnological museum of the Bureau of Science was transferred in September to the Philippine Library and Museum in accordance with Section 1691 of the Administrative Code and Executive Order No. 22, series of 1916.

LIBRARY

There have been no changes in the personnel of the library except the resignation of Mr. Luis Montilla, and in the temporary

apprentices. Mr. Montilla resigned effective November 12, after a period of nearly nine years of very satisfactory service.

The additions to the library during the year consisted of 4,520 bound volumes, 606 unbound volumes, and 1,189 pamphlets, making a total at the end of the year of 38,720 bound volumes, 3,969 unbound volumes, and 17,442 unbound pamphlets. At the beginning of the year 1,624 volumes were at the bindery, and 3,130 volumes were prepared and sent during the year. Of these, 2,095 were returned, leaving 2,659 volumes in the hands of the binder on December 31.

The record of technical work performed during 1917 is as follows:

	Titles.	Volumes.	Parts.	Cards.
Classification and cataloguing	386	6,500	577	1,651
Reclassification and cataloguing	240	1,298	123	928
Total	626	7,798	700	2,579
Printed cards prepared and filed				5,402
Total cards filed				7,981

The work completed on arrears has been greater than in any previous year, while the number of new publications catalogued has been somewhat smaller. The total number of cards filed was practically the same as that for 1916. Analytical cards for the entire series of the annual reports of the Smithsonian Institution were prepared and filed. The Library of Congress proof for the union catalogue has been prepared and filed as promptly as possible, in order to have this valuable material available for use in reference work and cataloguing. The cuts now number 5,221 and are all filed except 46, which are waiting for entry and preparation for the shelves. The distribution of duplicate material has been continued and extended. This work now includes the Philippine Constabulary, the faculty and students of the College of Medicine and Surgery, and a number of the student dormitories. The average number of books circulated daily was 45, and of books recorded as used in the library, 52. The number of foreign visitors has been smaller than in any recent year.

The course given in library science in the College of Liberal Arts, University of the Philippines, by the librarian of the Bureau of Science and others will do much to relieve the need for routine library assistants. However, until provision is made for training assistants in the well-established library schools of the United States for the very important and exacting duties of library work, as I have urged in my reports for 1915 and 1916,

there will be no available supply of competent employees for the higher positions on the library staff. Instruction to the students of the College of Medicine and Surgery in the use of the library and of medical literature has been continued. This work has been successful in increasing the efficiency and self-dependence of these students in the use of the library.

THE PHILIPPINE JOURNAL OF SCIENCE AND OTHER PUBLICATIONS

During 1917 the Philippine Journal of Science was issued as usual in four sections, each of which contained six numbers. Each section is separately paged and indexed. The following table shows the number of pages, plates, and text figures contained in each section of Volume XII (1917):

	Section A.	Section B.	Section C.	Section D.
Pages	316	360	391	436
Plates	11	10	17	19
Text figures	12	9	8	16

An arrangement was entered into between the Manila Medical Society and the Director of the Bureau of Science beginning with the calendar year 1917 for the publication of the minutes and abstracts of the proceedings of the Manila Medical Society as evenly distributed as possible throughout the six issues of Section B, Tropical Medicine, of the Philippine Journal of Science, as announced in the Philippine Journal of Science, Section B (1917), 12, 39. The proceedings have appeared in each number of Section B, Tropical Medicine, with the exception of number 4, when the society was adjourned for the summer. Advance copies of the proceedings were printed for distribution to the members of the society.

The numbers of the Philippine Journal of Science for Volume XII, 1917, contain the following articles. Names of members of the Bureau of Science staff are marked by asterisks.

SECTION A. CHEMICAL AND GEOLOGICAL SCIENCES AND THE INDUSTRIES

No. 1, January, 1917

*Brill, Harvey C. The fermentation of Philippine cacao.

*Heise, George W. The interaction of chloride of lime with the normal constituents of natural waters and sewage.

*Brill, Harvey C. A chemical investigation of the seeds of Pangium edule and Hydnocarpus alcalæ.

Review.

No. 2, March, 1917

*Cox, Alvin J. The study of copra and other coconut products.
*Brill, Harvey C., *Parker, Harrison O., and *Yates, Harry S. Copra and coconut oil.
*Parker, Harrison O., and *Brill, Harvey C. Methods for the production of pure coconut oil.
*Brill, Harvey C., and *Parker, Harrison O. The rancidity of Philippine coconut oil.

No. 3, May, 1917

*Wells, A. H. Destructive distillation of Philippine woods.
*Brill, Harvey C., and *Alincastre, Cecilio. The possible maximum vitamine content of some Philippine vegetables.
*Witt, J. C., and *Reyes, F. D. The effect of calcium sulphate on cement.
Wright, J. R., and *Heise, George W. The radioactivity of Philippine waters.

No. 4, July, 1917

*Brill, Harvey C., and *Wells, A. H. The physiological active constituents of certain Philippine medicinal plants: II.
*Brill, Harvey C. The antineuritic properties of the infusorial earth extract of the hydrolyzed extract of rice polishings.
*Brill, Harvey C., and *Williams, Robert R. The use of chaulmoogra oil as a specific for leprosy.

No. 5, September, 1917

*Brown, William H., and *Argüelles, Angel S. The composition and moisture content of the soils in the types of vegetation at different elevations on Mount Maquiling.
*Aguilar, R. H. A comparison of linseed oil and lumbang oils as paint vehicles.
*Heise, George W. The crater lake of Taal Volcano.
*Witt, J. C. Composition of brick and mortar in the Great Wall of China.
*Brill, Harvey C., and *Agcaoili, Francisco. Some limitations of the Kjeldahl method.

No. 6, November, 1917

*Brill, Harvey C., and *Thurlow, Leavitt W. Alcohol from discard molasses in the Philippine Islands.
*Heise, George W. The radioactivity of the waters of the mountainous region of northern Luzon.
*Heise, George W. The constancy in the radioactivity of certain Philippine waters.
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SECTION B. TROPICAL MEDICINE

No. 1, January, 1917

Shaklee, Alfred Ogle. Experimental acclimatization to the tropical sun.
*Schöbl, Otto. The influence of bile upon the distribution of cholera vibros in the digestive system of experimental cholera carriers.
Garcia, Faustino. Common intestinal parasites.
Guazon, Potenciano. A case of advanced pregnancy in the broad ligament.
Proceedings of the Manila Medical Society.

No. 2, March, 1917

*Schöbl, Otto, and *Panganiban, C. S. Experimental cholera carriers and immunity.

Mendoza-Guazon, Maria Paz. Study of the anatomico-pathologic lesions in one thousand Filipino children under five years of age.

Crowell, B. C., and *Johnston, John A. Bacteriologic investigation of fæces and bile of cholera cases and cholera carriers.

Proceedings of the Manila Medical Society.

No. 3, May, 1917

*Johnston, John A. The varying morphology of B. lepræ and the routine microscopic examination of nasal mucus in lepers.

Abriol, Rufino. Amœbic abscess of the liver among Filipinos.

Manlove, C. H. Two cases of balantidial colitis.

Proceedings of the Manila Medical Society.

No. 4, July, 1917

Manalang, C. Degeneration of peripheral nerves.

Ruth, Edward S., and Gibson, Robert B. Disappearance of the pigment in the melanophore of the Philippine house lizard.

Lowell, Paul McC. Essential factor in the treatment of pregnant cholera patients.

Hilario, J. S., and Wharton, L. D. Echynostoma ilocanum (Garrison). A report of five cases and a contribution to the anatomy of the fluke.

No. 5, September, 1917

*Schöbl, Otto. A survey of certain chemicals with regard to their bactericidal action on cholera vibrios within the body of experimental cholera carriers.

Manlove, C. H. Incidence of age, atheroma, and aneurisms as seen in autopsies of Filipinos.

*Schöbl, Otto, and *Monserrat, Carlos. Substitution of human blood cells by monkey's red corpuscles in performing the complement fixation test for syphilis.

Proceedings of the Manila Medical Society.

No. 6, November, 1917

Gomez, Liborio. Mohammedan medical practice in Cotabato Province.

Boynton, William Hutchins. A disease in cattle in the Philippine Islands similar to that caused by Anaplasma marginale Theiler.

Proceedings of the Manila Medical Society.

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SECTION C. BOTANY

No. 1, January, 1917

Brown, W. H., and *Heise, G. W. The application of photochemical temperature coefficients to the velocity of carbon dioxide assimilation.

Beccari, O. The origin and dispersal of Cocos nucifera.

Copeland, Edwin Bingham. New species and a new genus of Borneo ferns, chiefly from the Kinabalu collections of Mrs. Clements and Mr. Topping.

*Merrill, E. D. Koordersiocholoa javanica Merrill, a new genus and species of Gramineae from Java.

No. 2, March, 1917

Brotherus, V. D. The mosses of Amboina.
Beccari, O. A new species of Calamus from Amboina.
Radlkofer, L. A new species of Guioa from Amboina.
Brown, William H., and *Heise, George W. The relation between light intensity and carbon dioxide assimilation.
*Merrill, E. D. Notes on the flora of Kwangtung Province, China.
*Merrill, E. D. The dates of publication of the third edition of Blanco's "Flora de Filipinas."

No. 3, May, 1917

*Merrill, E. D. Two new genera and four new species of Philippine Compositae.
*Merrill, E. D. New Philippine Lauraceae.
*Merrill, E. D. New Philippine Myrsinaceae.
*Merrill, E. D. Studies on Philippine Rubiaceae, III.

No. 4, July, 1917

Brown, William H., *Merrill, E. D., and *Yates, Harry S. The revegetation of Volcano Island, Luzon, since the eruption of Taal Volcano in 1911.

No. 5, September, 1917

Smith, J. J. The Amboina Orchidaceae collected by C. B. Robinson.
*Merrill, E. D. New Philippine shurbs and trees.
Brown, William H., and *Yates, Harry S. The rate of growth of some trees on the Gedeh, Java.
*Yates, Harry S. Fungi collected by E. D. Merrill in southern China.

No. 6, November, 1917

Brown, W. H. The rate of growth of Podocarpus imbricatus at the top of Mount Banahao, Luzon, Philippine Islands.
Copeland, E. B. The genus Christiopteris.
*Merrill, E. D. New Philippine Melastomataceae.
*Yates, H. S. Some recently collected Philippine fungi.

SECTION D. GENERAL BIOLOGY, ETHNOLOGY, AND ANTHROPOLOGY

No. 1, January, 1917

Robinson, Elizabeth. Coccidæ of the Philippine Islands.

No. 2, March, 1917

Muir, Frederick. The Derbidæ of the Philippine Islands.

No. 3, May, 1917

Bezzi, M. Studies in Philippine Diptera, II.
Crawford, D. L. Philippine and Asiatic Psyllidæ.
*Seale, Alvin. The mosquito fish, Gambusia affinis (Baird and Girard), in the Philippine Islands.

No. 4, July, 1917

*Seale, Alvin. Sea products of Mindanao and Sulu, III: Sponges, tortoise shell, corals, and trepang.
Baker, C. F. A Philippine Aphrastobracon.
Muir, Frederick. A new genus of Derbidæ from Borneo.
Oshima, Masamitsu. Notes on a collection of termites from Luzon obtained by R. C. McGregor.
Wileman, E. D. Notes on Japanese Lepidoptera and their larvæ: Part IV.
Schultze, W. Fourth contribution to the coleoptera fauna of the Philippines.
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No. 5, September, 1917

*Taylor, Edward H. Brachymeles, a genus of Philippine lizards.
Baker, C. F. Ichneumonoid parasites of the Philippines, I. Rhogadinæ (Braconidæ), I.
Grouvelle, A. Nitidulidæ (Coléoptères) des îles Philippine récoltés par C. F. Baker, II.
Cockerell, T. D. A. The carpenter bees of the Philippine Islands.

No. 6, November, 1917

*Taylor, Edward H. Snakes and lizards known from Negros, with descriptions of new species and new subspecies.
Baker, C. F. Ichneumonoid parasites of the Philippines, II. Rhogadinæ (Braconidæ), II: The genus Rhogas.
Review.
Index.

Species Blancoanae: A Critical Revision of the Species of Plants Described by Blanco and by Llanos; a new and enlarged folder, entitled The Philippine Journal of Science and Other Publications of the Bureau of Science; and a comprehensive paper on Philippine Water Supplies are being printed. The following miscellaneous publications have been issued:

The Mineral Resources for 1916.
The Fifteenth Annual Report of the Director of the Bureau of Science.
Contents and Index; the Philippine Journal of Science, Volume I (1906) to Volume X (1915).
An Interpretation of Rumphius's Herbarium Amboinense.
A second edition of Press Bulletin 50.
A second edition of directions for Prophylactic Treatment Against Rabies.

The press bulletins issued during the year are as follows:

No. 61. Rare turtle in the Bureau of Science Aquarium. (Issued in English and in Spanish, December 23, 1916.)
No. 62. The Bureau of Science describes a simple method for cleaning silverware. (Issued March 3, 1917.)
No. 63. The alcohol industry of the tropics. (Issued in English and in Spanish, March 6, 1917.)
No. 64. Directions for taking soil samples. (Issued in English and in Spanish, March 8, 1917.)

No. 65. La sal gruesa no siempre es comestible. (Issued in Spanish only, March 12, 1917.)
No. 66. (Not issued.)
No. 67. La savia de la palmera (nipa) como materia prima para la fabricación del azúcar en cantidades comerciales. (Printed in Spanish only, Order No. 451, September 18, 1917.)
No. 68. Philippine substitute for cork. (Issued in English and in Spanish, July 13, 1917.)
No. 69. Foodstuffs, the use of which should be extended. (Issued in English and in Spanish, July 28, 1917.)
No. 70. The manufacture of roofing tiles. (Issued August 10, 1917.)
No. 71. Philippine Bureau of Science charts. (Printed in English and in Spanish, November, 1917.)
No. 72. The milk supply in the Philippine Islands. (Issued in English and in Spanish, August 23, 1917.)
No. 73. Some interesting notes on the sugar provinces of Luzon. (Issued in English and in Spanish, August 30, 1917.)
No. 74. A comparison of the manufacturing units in some of the centrals of the Philippine Islands. (Printed in English and in Spanish, December, 1917.)
No. 75. Methods of clarifying cane juice. (Printed in English and in Spanish, December, 1917.)
No. 76. Fish and fish products. (Issued in English and in Spanish, August 29, 1917.)
No. 77. Kapok. (Issued in English and in Spanish, September 1, 1917.)
No. 78. The castor oil plant in the Philippine Islands. The industry should be greatly extended. (Issued in English and in Spanish, September 19, 1917.)
No. 79. How to prepare coconut butter. (Issued in English and in Spanish, September 24, 1917.)
No. 80. Flour substitutes that are beneficial to health. (Issued in English and in Spanish, October 6, 1917.)
No. 81. On the methods of preservation, drying, or otherwise utilizing food products. (Issued in English and in Spanish, October 20, 1917.)
No. 82. Nutritive value of Philippine vegetables. (Issued in English and in Spanish, November 6, 1917.)
No. 83. Grow tañgan-tañgan. (Issued in English and in Spanish, November 8, 1917.)
No. 84. Philippine shark liver oil and fin possibilities. (Issued in English and in Spanish, December 11, 1917.)
No. 85. Copra and other coconut products, by Alvin J. Cox. (Printed in English and in Spanish. In press.
No. 86. Philippine fuels, by Alvin J. Cox. (Printed in English and in Spanish. In press.
No. 87. The Philippine Bureau of Science, by Alvin J. Cox. (Printed in English and in Spanish. In press.

The Bureau of Science has issued weekly reports of its work for the information of the public. A detailed account of the examinations and analyses for each week was given, of which the following will serve as an example:

The samples received at the Bureau of Science for ordinary examination

or analysis and the sera, vaccines, prophylactics, and other products disposed of during the week ending December 1, 1917, are as follows:

Specimens to be examined for cholera, 3,073; specimens of sputum for examination, 21; specimens to be examined for diphtheria, 26; samples of milk and other foods, Sampaloc specimens, and other miscellaneous materials for microscopical examination, 574; samples of milk and other foods for chemical examination, 24; samples of coconut oil for free fatty acids, 2; cloth for determination of cause of damage, 1; fertilizer for chemical analysis, 1; anay exterminator sold, 15 liters; rats to be examined for plague, 2,234; water for biological examination, 46; specimens to be examined for dysentery bacilli, 6; water for chemical examination, 2; special jobs, 2; urine for chemical examination, 2; photographs, 364; assays, 30; cements, 30; samples for toxicological analysis, 1; specimens to be mounted, 3; typhoid and paratyphoid vaccines, 6 ampuls; gonococcus vaccines, 42 ampuls; antidysenteric serum, 370 cc.; vaccine virus, 30,505 doses; antitetanic serum, 25,000 units; staphylococcus albus aureus vaccines, 4 ampuls; autogenous bacterial vaccine prepared, 2; streptococcus vaccines, 3 ampuls; staphylococcus streptococcus vaccine, 10 ampuls; book varnish sold, 2 liters; tikitiki extract, 4 bottles; drafting, 1.

Nine specimens are found positive for tuberculosis.

In addition interesting paragraphs about the work of the Bureau of Science were given, which are illustrated by the following samples:

All rats caught by the Health Service rat squad are sent to the Bureau of Science for examination for evidence of bubonic plague. The rat flea is the carrier of the plague bacillus. An infected rat has enlarged glands either in the groins, the axillæ, or the neck and a peculiar hemorrhagic œdema of the subcutaneous tissues, enlargement of the spleen, and a mottled appearance of the liver. Smears made form the cut surfaces of the glands, the spleen, and the liver show the typical plague bacilli upon appropriate staining. In cases of chronic plague infection fluid is often found in the pleural cavity.

Persons who handle food play an important rôle in the spread of disease; hence the importance as a measure for the control of epidemics of having fæcal specimens from servants examined for the ova of intestinal parasites, the cholera vibrio, and the bacillus of dysentery. This is especially true of cooks and muchachos serving at table. Such servants should wash their hands not only with soap and water, but also with a germicide.

The importance of the chronic bacillus carrier as a disseminator of disease, such as typhoid, dysentery (bacillary and amœbic), and cholera, is being every day brought home to the medical profession as well as to the laity. Servants engaged in the preparation of food should be required to have a certificate as to their freedom from infection and also to have reëxaminations made at specified intervals.

With the onset of the rainy season bacillary dysentery appears regularly to a greater extent than in any other season. This infectious disease, which presents itself as bloody diarrhœa accompanied by fever, claims many victims every year and is a fatal disease particularly among children.

The treatment of the disease by a serum, so-called serum therapy, has long been popular with prominent local physicians, but formerly foreign

imported serum was preferred to local products. It is most gratifying to note that recently the local profession seems to be using the serum prepared at the Bureau of Science more extensively than heretofore. So far as it was possible to obtain by personal communication the opinion of prominent physicians as to the efficacy of the serum, the reports are most satisfactory.

The testing of disinfectants to determine their unit value not only as to germicidal efficiency, but as to cost is also very important. A disinfectant that costs ₱2 per gallon, but which is of such strength that it may be diluted 1 part to 2 parts of water, is of more value than another costing ₱0.75 per gallon but which must be used undiluted.

A personal letter dated October 29, 1917, to Dr. Alvin J. Cox, Director of the Bureau of Science, from Dr. A. W. Sellards, formerly an employee of the Bureau of Science and now of the Harvard University School of Tropical Medicine, states:

"Your report for 1915 has just been received. I am very much pleased to see that the Bureau is so active. Incidentally you might be interested in knowing that an interesting statement was made in Panama concerning Dr. Barber's work on malaria. It was estimated that on one small job alone there, $150,000 would have been saved if they had had the results of some of his investigations in the Philippines."

Foods that spoil readily should not be kept in the ice box for more than ten or twelve hours and then only with a plentiful supply of ice. Housekeepers should inspect ice boxes at least weekly and see that all drain pipes are clean.

The Bureau of Science is greatly interested in securing data regarding Philippine Islands medicinal plants, this work being under the immediate direction of Dr. Leon Ma. Guerrero. One of the objects is the possible commercial utilization of Philippine drug plants in view of the high price demanded by the trade for certain drugs. From work already under way it seems evident that several local plants give distinct promise. Individuals knowing of special virtues of special plants are urgently requested to communicate with Doctor Guerrero.

The Bureau of Science tests for saccharin are believed to be interesting. Saccharin is an intensely sweet coal-tar derivative that possesses no food value. There are several classes of saccharin, the strongest having a sweetening power of about 500 times that of cane sugar. During the past few years, since the passage of the Food and Drugs Act, the compound has been found in all kinds of foods where it has been desired to conceal either inferiority of grade or a lessening of the nutritious sugar content of the product. In the United States the Reference Board of Consulting Experts decided that the addition of saccharin to food was an adulteration and should be prohibited by law. A daily ingestion of more than 0.3 gram produces an inhibiting action in the digestion of food.

All data available on the supply and utilization of lumbang oil as a paint oil has been supplied to several individuals and firms interested in the commercial exploitation of this product. A paper giving the general results of the experiments of the Bureau of Science on the drying qualities of lumbang oil will be soon published.

The blanks and labels required by the various divisions have been printed.

The mailing list of the Philippine Journal of Science for the past two years has been as follows:

	1916	1917
Paid subscriptions	328	415
Exchanges	477	485
Reviews	61	61
Free	48	40
Total mailing list	914	1,001

It is gratifying that during these disturbed times the Philippine Journal of Science has had an even greater increase in its paid subscription list than was recorded for 1916 over 1915.

At the first of the year Mr. R. C. McGregor was designated business manager of the Philippine Journal of Science in addition to his other regular work, since which time he has continued to perform the duties required of that office.

POWER PLANT

The personnel and the functions of the central power plant have remained unchanged.

The electric current generated and delivered at the switchboard is 243,198 kilowatt hours, at an average cost per kilowatt hour of ₱0.0803. This low cost is due to the fact that the producer-gas plant and the gas engine were operated almost continuously. The producer-gas unit has continued to be reliable with different kinds of coal, and the gas engine has been running as nicely as ever. The cost per kilowatt hour of electric current is slightly greater than last year on account of the higher price of coal and other materials. The total amount of steam generated in the boilers was 7,764,675 kilograms, at an average cost of ₱0.003811 per kilogram. The total gas generated for laboratory purposes was 1,237,470 cubic feet (35,045 cubic meters). This is a large increase in volume over former years, for the Mansfield gas-generating plant gas is now being diluted with producer gas. The average cost of production was ₱1.59 per 1,000 cubic feet.

There were 234 official shop requests for the Bureau of Science and 36 from all other sources. The new tikitiki press was regularly, and the coconut-fiber extracting machines were temporarily, installed. The large testing machine was removed to a more advantageous position, and accessories were added for the testing of timbers. The construction of an experimental ceramic kiln has been completed. An apparatus was made for

testing the wearing qualities of ropes. A suitable producer-gas plant hooper was made for utilizing coconut husks and shells. The fire brick lining of the producer was repaired, and modifications in the bearings of its centrifuges were made. Use of the small auxiliary water centrifuge has been discontinued. In addition, the boilers, engines, pumps, electrical equipment, automobiles, motorcycles, and other apparatus were regularly maintained and repaired.

Three students from the College of Electrical Engineering of the Ateneo de Manila have been allowed to practice in the afternoons in the Bureau of Science under the direction and discipline of the chief engineer.

CLERICAL DIVISION

Mr. C. J. Stancliff, acting chief clerk, was retired from the Philippine service on January 14, 1917, and Mr. F. R. Ycasiano, testing engineer, was temporarily detailed to the position. On June 1, 1917, Mr. Gabriel M. de Ubago was appointed as assistant chief clerk and designated acting chief clerk to relieve the technical employee who had been performing the duties. Mr. Ubago had been employeed in a wholesale import and export and commission house during the previous four years. He served in this institution as clerk and property officer from 1905 to 1913 and was very well equipped to assume the duties of chief clerk, which he has performed satisfactorily. There have been a number of changes and readjustments in the clerical personnel in an effort to acquire the greatest possible efficiency in handling the clerical part of the large amount of technical work that devolves upon the Bureau of Science. All of the stenographic work in the Bureau of Science is now done by Filipinos. Several new clerks and junior stenographers have been appointed to fill positions left vacant by resignations and to care for the regular routine work. The property, accounting, and filing offices are now well organized, and the daily work of each is very intelligently handled and kept up-to-date.

The ground around the new operating and bleeding room has been filled and planted to mulberries. The parking of the Bureau of Science grounds is now completed, and they are very attractive.

The breeding of guinea pigs and rabbits has much improved. New rabbit-breeding cages have been made with heavy wire mesh floors. This arrangement permits perfect cleanliness and does not afford lodgment for the spores of the fungus that heretofore have caused much trouble by growth upon the noses, ears, feet, etc., of the rabbits. The indications are that within a few

months the Bureau of Science will be able to raise a sufficient supply of rabbits for its needs. Heretofore the Bureau of Science has been inconvenienced by the failure to secure monkeys during the dry season, for at this time those in the wild state have plenty of fruit and other food and will not enter traps. We are now equipped to care for a year's supply, and in the future monkeys will be purchased when they are easily obtainable and kept until needed.

PHOTOGRAPHY

The photographer has made several provincial trips to make still photographs and cinematograph films for the Government and for private parties, as well as the usual amount of work for the Philippine General Hospital, for the College of Medicine and Surgery, University of the Philippines, and for other Government bureaus and offices. Mounted, plain, and colored lantern slides, prints, etc., have been made. An itemized record of the photographic work performed is as follows:

Negatives:	
5 by 7	755
8 by 10	48
Prints:	
5 by 7	6,508
8 by 10	968
Miscellaneous sizes	1,122
Direct enlargements	71
Redeveloped (sepia tone), 5 by 7	23
Developing:	
Plates, 5 by 7	226
Films, rolls (exposures)	21
Lantern slides:	
Colored	246
Uncolored	209
Transparencies, colored	32
Cinematograph film:	
Positive, feet	600
Negative, feet	600

RECOMMENDATIONS

During the past calendar year the Bureau of Science received an appropriation of ₱381,810 for its work. As shown on page 4, the work of the Bureau of Science has increased out of all proportion with its appropriation. The amount made available should be very much increased in order to enable the Bureau of Science to keep abreast with development and to perform the necessary work in the many lines that are assigned by law. Additional, efficient, well-trained, technical chemists with years of practical experience are needed, as pointed out on pages

32, 64, and 66, for analytical, investigative, and informant work in the enforcement of the Food and Drugs Act and amendments; with regard to planting, harvesting, and recovering sugar most efficiently and economically; for the chemical, pharmaceutical, and physiological studies of the active constituents of medicinal plants; and in order satisfactorily to perform the routine work requested by other branches of the Government, commercial houses, and private parties. The field work on water analysis described on page 47 will surely become more important each year, and I cannot too strongly recommend that this be continued and enlarged. The end in view is not a compilation of a mass of analyses, but a real water field-survey, which only highly trained men are capable of making. The geologists available to the Bureau of Science are very inadequate, and the work cannot be done with the seriously depleted condition of the staff, as indicated on page 68. The Bureau of Science especially needs an entomologist, as discussed on page 42, to carry on work involving coöperation between bacteriologists, marine biologists, and others. The Bureau should also have a sericulturist to guide the work of rearing silkworms and developing the culture of silk in the Philippine Islands into a large industry, as pointed out on page 44. Without such an employee there is grave danger that the industry in the Philippine Islands will be discredited, if it is not an entire failure. Much important constructive work that should be done has remained undone for lack of personnel, and there is the greatest and keenest need of more scientific employees for extending economic research in every line, as shown on page 4.

The Bureau of Science should be provided with demonstrators (compare page 7). The extension of publicity propaganda by word of mouth, to supplement written directions, is felt along all economic and industrial lines, in order to bring about needed reforms and development, to explain to the public the collected data and results of experiments, to demonstrate new and improved methods, and to introduce new industries. The printing fund of the Bureau of Science is inadequate for making of record the available scientific information without doing any special publicity work. An appropriation for demonstrators should be made, and that for printing should be increased.

The demand for serums and vaccines is greater than the Bureau of Science can supply, as indicated on page 26, and there is great opportunity for the commercialization of this work in the Philippine Islands if proper facilities are provided. The

Bureau of Science now has a modern operating and bleeding room, and this should be extended to provide for the serum laboratory in the same building. As shown on page 5, a small wooden laboratory should be provided for the taxidermist, and the space now used by him should be devoted to the preparation and keeping of tetanus cultures, tetanus toxins, and plague cultures. Such an arrangement will safeguard any possible contamination of biological products by tetanus or plague germs. The herbarium collections of the Bureau of Science are now inadequately housed in the east wing. Much time is lost in consulting the collections on account of their inconvenient arrangement, and the space is already insufficient. Adequate, properly arranged quarters should be provided for this valuable collection, and the space now used for it should be devoted to the growing library. Almost every section of the Bureau of Science has inadequate laboratory space, and the chemists and others are working in crowded rooms. The quarters for tests and investigations of, and housing machines for, the regular testing of the Manila city gas under the municipal ordinance and of all classes of structural and other materials, including cements, concretes, mortars, cement pipes, tiles, building and paving blocks, bricks, stones, ores, tars, asphalts, pitches, dust preventatives, road materials, ties, reënforcing iron, steel, rope, wire, cloth, and other similar materials, are much too small. As shown on page 65, the Director of Public Works advises "that cement testing requirements will greatly increase from now on." The need for greater space can be met best by the erection of a wing on the west end of the main building corresponding to the one at the east end.

Funds should be appropriated for a commercial marine and fresh-water products (fisheries) laboratory, survey, and hatchery; for fish propagation, culture, canning, preservation, and conservation; and for a fishery school. The greatly increased cost of imported foods and meats makes it imperative that the fisheries resources be exploited. Philippine fisheries should not only be improved, but they should be developed into a great industry, as pointed out on pages 9–11.

As discussed on page 60, the Bureau of Science has demonstrated the suitability of Philippine coal for use in producer-gas plants. However, there are many instances where the use of a producer-gas plant is impracticable. Most recent developments in the use of coals in the United States have been in the use of powdered coal. The firing of pulverized Philippine

coal by means of special equipment is entirely feasible, and the use of this kind makes Philippine coal applicable to all purposes. This is a very important subject, and provision should be made for gathering information concerning this new development and its application in the Philippine Islands.

As stated on page 19, the Bureau of Science has proposed a bill providing for the technical education of Filipinos in the United States. The program of Philippine industrial development of the present Philippine Legislature will require a large number of thoroughly trained technical men, and provision for training men in factories and technical schools is much needed. In previous years I have advocated sending the more advanced Bureau of Science library assistants to the United States for further professional training. An intensification of the professional training of Filipino technical employees and eligibles will yield most valuable results, and a bill similar to the one prepared should be passed.

The manufacture by the Bureau of Science of the extract of tikitiki for the treatment of infantile beriberi is of very great practical importance, as shown on page 20, and the lives of thousands of children ill with beriberi have been saved by the administration of this prophylactic. The work should be enlarged in order that no request for this extract need be refused. Provision should be made whereby all legitimate requests for the extract can be complied with by the Bureau of Science. An annual appropriation of ₱15,000 should be available to the Bureau of Science for this work.

Tables showing the routine work performed and supplies manufactured and disposed of during the calendar year 1917 by the Bureau of Science, and the financial statement showing the appropriation and how it was expended, are attached hereto.

Respectfully submitted.

Director, Bureau of Science.

To the Honorable
The SECRETARY OF AGRICULTURE AND NATURAL RESOURCES.

TABLE I.—*Comparative table of routine work performed and supplies manufactured and disposed of during the fiscal year 1917, as compared with the fiscal year 1916, by number or quantity and by value, arranged by subdivisions of the Bureau of Science.*

Subdivision of the Bureau of Science.	Samples or units.		Cash work.			
			Samples or units.		Pesos.	
	1916	1917	1916	1917	1916	1917
General, inorganic, and physical chemistry:						
Metals and alloys	25	34	24	29	144.00	166.00
Rocks, minerals, natural pigments, and similar substances	71	5	68	5	475.00	39.00
Clays, shales, limestones, limes, wall plasters, cement, and slags	10	14	2	11	23.00	115.00
Fertilizers	72	26	34	24	329.00	221.00
Soils and similar substances	18	135	3	96	25.00	570.00
Coal analyses	10	29	6	23	155.00	405.00
Calorimetric tests of fuels	7	13	3	12	96.00	240.00
Paints and varnishes	14	4	14	4	184.00	96.50
Waters	202	232	15	21	294.00	388.00
Crude chemical and miscellaneous analyses	166	12	157	9	499.00	123.00
Standard solutions (in liters)	304	244	45	49	89.99	176.00
Physical test of wire, twine, fiber, textile, paper, and similar articles	4	4	3	3	12.00	11.00
Cements	15,790	5,687	15,676	5,687	12,015.80	6,881.55
Compression, tensile, or transverse strength of concrete, stone, mortar, rope, iron and steel, etc	468	310	457	310	482.75	485.65
Standardization of road materials	67	33	67	30	410.10	170.00
Standardization of units of measure:						
Lengths	679	----------	679	----------	247.75	----------
Capacities	56	674	56	674	83.60	282.70
Weights	20	104	20	104	23.85	56.60
Miscellaneous	79	42	78	40	162.10	212.60
Total	18,062	7,602	17,407	7,131	15,751.94	10,639.70

TABLE I.—*Comparative table of routine work performed and supplies manufactured and disposed of, etc.*—Continued.

Subdivision of the Bureau of Science.	Samples or units.		Cash work.			
			Samples or units.		Pesos.	
	1916	1917	1916	1917	1916	1917
Organic chemistry:						
Urines, clinical and toxicological analyses	196	292	110	164	393.00	690.00
Essential oils and essences	10	12	10	12	71.00	109.00
Petroleum and products, copra, and similar materials	60	164	36	148	461.50	757.50
Linseed and castor oils	17	16	6	5	103.00	63.00
Gums, resins, and similar materials	2	9	2	9	20.00	86.00
Paper and similar materials	135	99	----	----	----	----
Gastric juice, clinical examinations	5	3	2	----	8.00	----
Foods and alcohols and beverages	1,164	736	123	186	147.67	859.00
Food preservatives and coloring matters	27	144	----	16	----	106.00
Medicines and similar articles	120	177	54	22	651.60	350.00
Miscellaneous chemical analyses and examinations	25	67	16	61	122.00	258.00
Total	1,761	1,719	359	623	1,977.77	3,278.50
Mines:						
Assays	518	386	507	383	1,341.50	1,308.85
Biological laboratory:						
Fæces	266,676	161,949	171	320	427.00	832.00
Sputum	330	822	46	78	138.00	177.00
Blood	47	92	22	63	148.00	314.00
Culture	4	10	4	10	25.00	25.00
Widal test	615	366	2	8	6.00	18.00
Wassermann test	1,689	778	239	331	2,390.00	3,310.00
Leprosy	555	888	1	1	3.00	3.00
Urines	5	----	----	----	----	----
Gonococci	17,169	16,715	32	30	96.00	90.00
Waters	4,108	2,319	12	----	309.00	----
Histological examinations	7	11	6	6	60.00	60.00
Rabies	18	3	----	----	----	----
Rats for plague	69,556	113,799	----	----	----	----
Miscellaneous biological examinations	4,866	7,110	13	5,104	94.00	143.20
Total	365,645	304,862	548	5,951	3,696.00	4,972.20

TABLE I.—*Comparative table of routine work performed and supplies manufactured and disposed of, etc.*—Continued.

Subdivision of the Bureau of Science.	Samples or units.		Cash work.			
			Samples or units.		Pesos.	
	1916	1917	1916	1917	1916	1917
Serum section of the biological laboratory:						
Vaccine virus (doses)	1,523,703	1,338,469	1,523,703	1,338,469	17,417.80	14,296.18
Mallein (doses)	707	308	707	308	707.00	308.00
Miscellaneous sera and preparations (cubic centimeters)	2,720,437	2,523,810	2,720,437	2,523,810	8,316.67	9,941.62
Total	4,244,847	3,862,587	4,244,847	3,862,587	26,441.47	24,545.80
Miscellaneous:						
Photographs	4,916	9,382	3,500	4,298	1,275.45	1,772.95
Natural history specimens	24	19	24	19	451.38	488.77
Shop work	337	260	13	79	69.88	164.48
Miscellaneous work	69	33	69	11	8,343.44	5,619.68
Supplies	1,146	8,198	1,146	8,198	1,867.46	2,841.01
Sales of publications	----------	----------	----------	----------	3,551.42	4,037.50
Refunded work not done, etc. (deducted)	----------	----------	----------	----------	(202.61)	(250.07)
Power, gas, etc	----------	----------	----------	----------	16,769.98	22,036.92
Total	6,492	17,892	4,752	12,605	32,126.40	36,711.24
Grand total	4,637,325	4,195,048	4,268,420	3,889,280	81,335.08	81,456.29

TABLE II.—*Comparative table of routine work performed and supplies manufactured and disposed of during the fiscal year 1917, as compared with the fiscal year 1916, by number or quantity and by value, arranged with reference to Government and other patronage.*

Customer.	Samples or units.		Cash work.			
			Samples or units.		Pesos.	
	1916	1917	1916	1917	1916	1917
Bureau of Agriculture:						
Fertilizers	38					
Soils and similar substances	13	27				
Crude chemical and miscellaneous analyses	5		3		3.00	
Compression, tensile, or transverse strength of concrete, stone, mortar, rope, iron and steel, etc	3		3		3.00	
Foods and alcohols and beverages	34	24				
Miscellaneous chemical analyses and examinations		2				
Shop works		2		2		5.50
Photographic work	2		2		1.80	
Total	95	55	8	2	7.80	5.50
Bureau of Civil Service:						
Photographic work	85	120	85	120	17.00	19.55
Bureau of Customs:						
Metals and alloys		1				
Foods and alcohols and beverages		10				
Food preservatives and coloring matters		4				
Waters, biological	80	21				
Petroleum and products, copra, and similar materials	1	11				
Miscellaneous		1				
Linseed oils	1					
Medicines and similar articles	1	6				
Assay		3				
Fæces	45	2				
Sputum	1	1				
Rabies	1					
Miscellaneous biological work and examinations	1					
Total	131	60				

TABLE II.—*Comparative table of routine work performed and supplies manufactured and disposed of, etc.*—Continued.

Customer.	Samples or units.		Cash work.			
			Samples or units.		Pesos.	
	1916	1917	1916	1917	1916	1917
Bureau of Education:						
Soils and similar substances		5				
Miscellaneous		1				
Photographic work	28	104	28	104	24.30	77.34
Supplies	7		7		26.00	
Total	35	110	35	104	50.30	77.34
Executive Bureau:						
Soils and similar substances	2					
Photographic work	253	8	253	8	44.37	2.20
Total	255	8	253	8	44 37	2.20
Bureau of Forestry:						
Fertilizers		1				
Photographic work	188	63	188	63	28.56	15.75
Total	188	64	188	63	28.56	15.75
Philippine Health Service:						
Clays, shales, limestones, limes, wall plasters, cements, and slags	1					
Waters, chemicals	7	1				
Waters, biological	2,862	1,927				
Crude chemical and miscellaneous analyses	1					
Cements	11		11		18.00	
Urines, clinical and toxicological analyses	85	111				
Petroleum and products, copra, and similar materials	4					
Linseed and castor oils	1	5				
Gastric juice, clinical examinations	2	2				
Foods and alcohols and beverages	957	498				
Food preservatives and coloring matters	27	124				
Medicines and similar articles	52	146				
Miscellaneous chemical analyses and examinations	7	10	2	10	4.10	80.00
Fæces	140,484	31,736				
Sputum	279	732				
Blood	21	27				
Widal test	613	353				

TABLE II.—*Comparative table of routine work performed and supplies manufactured and disposed of, etc.*—Continued.

Customer.	Samples or units.		Cash work.			
			Samples or units.		Pesos.	
	1916	1917	1916	1917	1916	1917
Philippine Health Service—Continued.						
Wassermann test	127	30				
Leprosy	552	887				
Urines	5					
Gonococci	17,136	16,685				
Histological examinations	1	2				
Rabies	17	3				
Rats for plague	69,221	113,783				
Miscellaneous biological work and examinations	4,811	1,981				
Vaccine virus	1,359,700	1,261,793	1,359,700	1,261,793	13,597.00	12,617.93
Miscellaneous sera and preparations	1,562,011	1,027,071	1,562,011	1,027,071	2,759.64	2,082.64
Photographic work	279	272	279	272	144.12	280.40
Supplies		2,347		2,347		56.90
Total	3,159,274	2,460,526	2,922,003	2,291,493	16,522.86	15,117.87
Bureau of Internal Revenue:						
Standardization of weights	2	3	2	3	5.00	6.50
Foods and alcohols and beverages	8	12		12		50.00
Medicines and similar articles	7					
Photographic work	161	5	161	5	85.45	1.00
Total	178	20	163	20	90.45	57.50
Bureau of Justice:						
Urines, clinical and toxicological analyses		4		4		180.00
Medicines and similar articles	46	18	46	18	460.00	310.00
Blood	1	1	1	1	75.00	75.00
Total	47	23	47	23	535.00	565.00
Philippine Assembly:						
Photographs		11		11		37.75
Bureau of Lands:						
Soils and similar substances		1				
Cements		1		1		2.00
Standardization of road materials		3				
Miscellaneous		5		5		2.00

TABLE II.—*Comparative table of routine work performed and supplies manufactured and disposed of, etc.*—Continued.

Customer.	Samples or units.		Cash work.			
			Samples or units.		Pesos.	
	1916	1917	1916	1917	1916	1917
Bureau of Lands—Continued.						
Miscellaneous chemical analyses and examinations		2				
Total		12		6		4.00
Philippine Library and Museum:						
Photographic work		26		26		16.00
Philippine National Guard:						
Vaccine virus		650		650		6.50
Philippine Constabulary:						
Urines, clinical and toxicological analyses		2				
Blood		1				
Leprosy	2					
Miscellaneous biological work and examinations	1	4		4		40.00
Vaccine virus	1,300	1,500	1,300	1,500	13.00	15.00
Miscellaneous sera and preparations	3,030	60	3,030	60	54.00	24.00
Total	4,333	1,567	4,330	1,564	67.00	79.00
Bureau of Posts:						
Coal analysis		1				
Bureau of Printing:						
Paper and similar materials	135	99				
Medicines and similar articles	1					
Linseed oils	1					
Total	137	99				
Bureau of Prisons:						
Urines, clinical and toxicological analyses		2				
Gastric juice	1	1				
Foods and alcohols and beverages		1				
Medicines and similar articles	1	2				
Fæces	112,216	124,695				
Widal test		5				
Wassermann test	1,323	417				
Rats for plague		7				

TABLE II.—*Comparative table of routine work performed and supplies manufactured and disposed of, etc.*—Continued.

Customer.	Samples or units.		Cash work.			
			Samples or units.		Pesos.	
	1916	1917	1916	1917	1916	1917
Bureau of Prisons—Contd.						
Histological examinations		8				
Miscellaneous sera and preparations		1		1		6.67
Waters, biological	9					
Miscellaneous biological work and examinations	31	8				
Photographic work	98		98		119.53	
Total	113,679	125,142	98	1	119.53	6.67
Bureau of Public Works:						
Crude chemical and miscellaneous analyses	19		19		57.00	
Standard solutions (in liters)	87		11		20.87	
Cements	1,692	520	1,692	520	2,936.60	993.50
Compression, tensile, or transverse strength of concrete, stone, mortar, rope, iron and steel, etc	110	195	110	195	121.95	170.00
Standardization of road materials	5	11	5	11	25.00	57.00
Paints and varnishes	2	1	2	1	36.00	36.00
Petroleum and products, copra, and similar materials		1				
Waters, chemical	139	77				
Waters, biological	26					
Photographic work		129		129		19.44
Supplies		31		31		1.00
Total	2,080	965	1,839	887	3,197.42	1,276.94
Bureau of Quarantine Service:						
Urines, clinical and toxicological analyses		1				
Fæces	13,517	4,789		21		63.00
Rats for plague	335	9				
Vaccine virus	9,000	7,000	9,000	7,000	90.00	70.00
Photographic work	30		30		49.30	
Total	22,882	11,799	9,030	7,021	139.30	133.00

TABLE II.—*Comparative table of routine work performed and supplies manufactured and disposed of, etc.*—Continued.

Customer.	Samples or units.		Cash work.			
			Samples or units.		Pesos.	
	1916	1917	1916	1917	1916	1917
Bureau of Science:						
Metals and alloys		2				
Rocks, minerals, natural pigments, and similar substances	2					
Clays, shales, limestones, limes, wall plasters, cements and slags	5	3				
Fertilizers		1				
Coal analyses	2	5				
Calorimetric tests of fuels	4	1				
Soils and similar substances		6				
Crude chemical and miscellaneous analyses	5	3				
Standard solutions (in liters)	183	195				
Cements	114					
Foods and alcohols and beverages		2				
Compression, tensile, or transverse strength of concrete, stone, mortar, rope, iron and steel, etc.	2					
Fæces		12				
Petroleum and products, copra, and similar materials	4	3				
Sputum		11				
Urines, clinical and toxicological analyses	1	12				
Linseed and castor oils	2	5				
Blood		1				
Miscellaneous chemical analyses and examinations	2	2				
Waters, chemical	14	128				
Waters, biological	372	371				
Assays	5					
Miscellaneous biological work and examinations	4	30				
Photographic work	1,416	5,083				
Shop work	324	181				
Total	2,461	6,056				

TABLE II.—*Comparative table of routine work performed and supplies manufactured and disposed of, etc.*—Continued.

Customer.	Samples or units.		Cash work.			
			Samples or units.		Pesos.	
	1916	1917	1916	1917	1916	1917
Bureau of Supply:						
Metals and alloys	1	2				
Crude chemical and miscellaneous analyses	2		1		5.00	
Standard solutions (in liters)	1		1		0.62	
Physical tests of wire, twine, fibers, textiles, paper, and similar materials	1	1				
Cements	13,662	4,817	13,662	4,817	7,926.85	4,613.30
Paints and varnishes	7	1	7	1	120.00	6.50
Standardization of units of measures—						
Lenghts	679		679		247.75	
Capacities		615		615		221.70
Weights	12	101	12	101	9.85	50.10
Miscellaneous	1	4		4		8.80
Petroleum and products, copra, and similar materials	15	1				
Linseed and castor oils	6	1				
Foods and alcohols and beverages	42	15				
Medecines and similar articles	4	1				
Miscellaneous chemical analyses and examinations		32		32		10.00
Waters, chemical	17	5				
Waters, biological	15					
Miscellaneous biological work and examinations	5	9				
Vaccine virus		25,825		25,825		258.25
Miscellaneous sera and preparations	23	49,857	23	49,857	9.70	4,799.60
Supplies	1	280	1	280	4.00	72.10
Total	14,494	81,567	14,386	81,532	8,323.77	9,935.35
University of the Philippines:						
Vaccine virus		50		50		0.50
Faeces	243	416				
Micellaneous sera and preparations	32,060	7	32,060	7	34.00	1.57
Photographic work	251	265	251	265	82.52	54.75

TABLE II.—*Comparative table of routine work performed and supplies manufactured and disposed of, etc.*—Continued.

Customer.	Samples or units.		Cash work.			
			Samples or units.		Pesos.	
	1916	1917	1916	1917	1916	1917
University of the Philippines—Continued.						
Shop work	1	5	1	5	8.27	24.73
Supplies	56	540	56	540	3.05	48.00
Total	32,611	1,283	32,368	867	127.84	129.55
City of Manila:						
Clays, shales, limestones, limes, wall plasters, cements, and slags	1		1		8.00	
Crude chemical and miscellaneous analyses	6		6		78.00	
Standard solutions (in liters)	13	46	13	46	48.50	160.00
Cements	82		82		308.70	
Standardization of road materials	2		2		25.00	
Compression, tensile, or transverse strength of concrete, stone, mortar, rope, iron and steel, etc	16	24	7	24	14.00	12.50
Linseed oils	1		1		18.00	
Miscellaneous chemical analyses and examinations		1		1		15.00
Waters, biological	741					
Blood	4					
Photographic work		1				
Miscellaneous sera and preparations	150,001	100,000	150,001	100,000	152.40	100.00
Total	150,867	100,072	150,113	100,071	652.60	287.50
Provinces and municipalities:						
Metals and alloys	4		4		28.00	
Crude chemical and miscellaneous analysis	16		16		252.00	
Cements	23		23		201.65	
Standardization of units of measures		24		24		24.00
Clays, shales, limestones, limes, wall plasters, cements, and slags	3	1	1	1	15.00	30.00
Compression, tensile, or transverse strength of concrete, stone, mortar, rope, iron and steel, etc	323	65	323	65	310.80	223.15

TABLE II.—*Comparative table of routine work performed and supplies manufactured and disposed of, etc.*—Continued.

Customer.	Samples or units.		Cash work.			
			Samples or units.		Pesos.	
	1916	1917	1916	1917	1916	1917
Provinces and municipalities—Continued.						
Coal analyses	1	3	1	3	35.00	105.00
Standardization of road materials	54	19	54	19	290.60	113.10
Medicines and similar articles	3	3	3	3	70.00	30.00
Waters, chemical	2	4	1	4	6.00	70.00
Blood		1		1		75.00
Vaccine virus	80,000	20,000	80,000	20,000	2,400.00	600.00
Miscellaneous sera and preparations	53,525		53,525		1,559.74	
Paints and varnishes	1		1		8.00	
Total	133,955	20,120	133,952	20,120	5,176.79	1,270.25
United States Army and Navy:						
Metals and alloys	1	1	1	1	24.00	4.00
Waters, chemical		9		9		190.00
Cements	48	76	48	76	240.00	291.25
Compression, tensile, or transverse strength of concrete, stone, mortar, rope, iron and steel, etc	6	6	6	6	19.00	42.00
Crude chemical and miscellaneous analyses	5		5		36.00	
Urines, clinical and toxicological analyses	1		1		50.00	
Standardization of units of measures	6		6		9.00	
Petroleum and products, copra, and similar materials	3	7	3	7	83.00	39.00
Linseed and castor oils	3	2	3	2	45.00	30.00
Foods and alcohols and beverages	5	8	5	8	50.00	80.00
Miscellaneous biological work and examinations	1		1		3.00	
Vaccine virus	21,410	17,824	21,410	17,824	685.00	583.90
Mallein	707	306	707	306	707.00	306.00
Miscellaneous sera and preparations	448,927	319,743	448,927	319,743	1,620.85	844.50
Supplies	253	111	253	111	77.45	50.60
Total	471,376	338,093	471,376	338,093	3,649.30	2,461.25

TABLE II.—*Comparative table of routine work performed and supplies manufactured and disposed of, etc.*—Continued.

Customer.	Samples or units.		Cash work.			
			Samples or units.		Pesos.	
	1916	1917	1916	1917	1916	1917
Miscellaneous:						
Metals and alloys	19	28	19	28	92.00	162.00
Clays, shales, limestones, limes, wall plasters, cements, and slags		10		10		85.00
Rocks, minerals, natural pigments, and similar substances	69	5	58	5	475.00	39.00
Fertilizers	34	24	34	24	329.00	221.00
Soils and similar substances	3	96	3	96	25.00	570.00
Coal analyses	7	20	5	20	120.00	300.00
Calorimetric tests of fuels	3	12	3	12	96.00	240.00
Crude chemical and miscellaneous analyses	107	9	107	9	68.00	123.00
Paints and varnishes	4	2	4	2	20.00	54.00
Physical tests of wire, twine, fibers, textiles, paper, and similar articles	3	3	3	3	12.00	11.00
Standard solutions (in liters)	20	3	20	3	20.00	16.00
Cements	158	273	158	273	384.00	1,081.50
Compression, tensile, or transverse strength of concrete, stone, mortar, rope, iron and steel, etc	8	20	8	20	14.00	38.00
Standardization of road materials	6		6		69.50	
Standardization of units of measures (capacities)	56	35	56	35	83.60	37.00
Miscellaneous inorganic analyses	78	31	76	31	158.00	206.80
Urines, clinical and toxicological analyses	109	160	109	160	343.00	510.00
Essential oils and essences	10	12	10	12	71.00	109.00
Petroleum and products, copra, and similar materials	33	141	33	141	378.50	718.50
Linseed and castor oils	2	3	2	3	40.00	33.00
Gums, resins, and similar materials	2	9	2	9	20.00	86.00

TABLE II.—*Comparative table of routine work performed and supplies manufactured and disposed of, etc.*—Continued.

Customer.	Samples or units.		Cash work.			
			Samples or units.		Pesos.	
	1916	1917	1916	1917	1916	1917
Miscellaneous—Continued.						
Gastric juice, clinical examinations	2		2		8.00	
Foods and alcohols and beverages	118	166	118	166	97.67	729.00
Food preservatives and coloring matters		16		16		106.00
Medicines and similar articles	5	1	5	1	121.60	10.00
Miscellaneous chemical analyses and examinations	16	18	16	18	122.00	153.00
Assays	513	383	507	383	1,341.50	1,308.85
Waters, chemical	14	8	14	8	288.00	128.00
Waters, biological	12		12		309.00	
Fæces	171	299	171	299	427.00	769.00
Sputum	50	78	46	78	138.00	177.00
Blood	21	61	21	61	73.00	164.00
Culture	4	10	4	10	25.00	25.00
Widal test	2	8	2	8	6.00	18.00
Wassermann test	239	331	239	331	2,390.00	3,310.00
Leprosy	1	1	1	1	3.00	3.00
Gonococci	32	30	32	30	96.00	90.00
Histological examinations	6	6	6	6	60.00	60.00
Mallein		2		2		2.00
Miscellaneous biological work and examinations	12	5,100	12	5,100	91.00	103.20
Vaccine virus	52,193	3,827	52,193	3,827	631.80	144.10
Miscellaneous sera and preparations	470,770	1,027,071	470,770	1,027,071	2,090.34	2,082.64
Photographic work	2,125	3,295	2,125	3,295	678.50	1,248.77
Natural history specimens	24	19	24	19	451.38	488.77
Shop work	12	72	12	72	61.61	134.25
Miscellaneous work	69	11	69	11	8,343.44	5,619.68
Supplies	829	4,889	829	4,889	1,756.96	2,612.41
Sales of publications					3,551.42	4,037.50
Refunded, work not done, etc, (deducted)					(202.61)	(250.07)
Power, gas, etc					16,769.98	22,036.92
Total	527,971	1,046,598	527,956	1,046,598	42,548.19	49,951.82
Grand total	4,687,134	4,195,048	4,268,230	3,889,280	81,298.08	81,456.29

TABLE III.—*Comparative statement showing expenditures and income during the fiscal year 1917 (January 1 to December 31, 1917) as compared with the fiscal years 1915 and 1916.*

EXPENDITURES.

Item.	Fiscal year.		
	1915	1916	1917
Salaries and wages, etc.:	*Pesos.*	*Pesos.*	*Pesos.*
Salaries and wages, including accrued leave	191,349.75	231,180.22	218,161.41
Travel expenses of personnel	12,026.16	12,964.40	10,772.71
Total	203,375.91	244,144.62	228,934.12
Apparatus, supplies, etc.:			
Consumption of supplies and materials, including subscriptions	73,156.96	72,929.96	88,028.54
Apparatus and equipment, including books	14,448.88	21,429.44	13,449.10
Total	87,605.84	94,359.40	101,477.64
Miscellaneous:			
Rental of buildings	682.50	481.50	360.00
Postal, telegraph, telephone, and cable service	4,764.62	3,990.65	3,944.89
Freight, express and delivery service	1,176.32	1,725.92	1,157.99
Printing and binding reports, documents and publications	33,590.61	21,238.19	25,000.00
Illumination and power service	1,647.02	1,628.53	1,633.66
Miscellaneous service	3,079.95	4,520.06	1,305.07
Maintenance and repairs of furniture and equipment	4,409.75	4,200.00	4,200.00
Total	49,350.77	37,784.85	37,601.61
Grand total	340,332.52	376,288.87	368,013.37

INCOME.

Receipts from operation	98,197.62	81,335.08	81,456.29
Prior year income	2,665.88	647.89	
Sales of supplies	0.73		
Sales of fixed assets	25,889.93	1,575.70	1,524.42
Other			1,688.74
Total	126,754.16	83,558.67	84,669.45
Appropriation account:			
Appropriated	360,895.50	371,976.00	381,810.00
Alloted by the Emergency Board	10,000.00	25,000.00	28,000.00
Brought forward for accounts payable	58,891.87	27,856.39	29,518.53
Restored from previous fiscal years		20,039.31	10,160.77
Total	429,787.37	444,871.70	449,489.30

MISCELLANEOUS ACCOUNTS (1917).

Item.	Available.	Expended.	Balance.
Tikitiki distribution, Acts Nos. 2376 and 2714	13,104.81	3,768.80	9,336.01
Improvement of the Aquarium, Act No. 2494	81.73	4.58	77.15
Replacement fund (Iloilo fire)	2,784.43	538.23	2,246.20
Serum Laboratory Improvement, Act No. 2704	8,000.00	7,003.93	996.07
Publicity Service for Philippine Food Commission (alloted by the Emergency Board)	14,900.00	12,661.20	2,238.80
Total	38,870.97	23,976.74	14,894.23

ILLUSTRATIONS

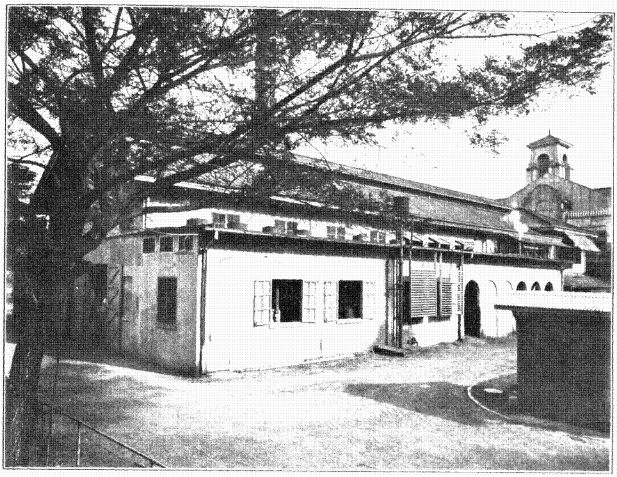

Fig. 1. Rear view of Bureau of Science main building, showing power plant.

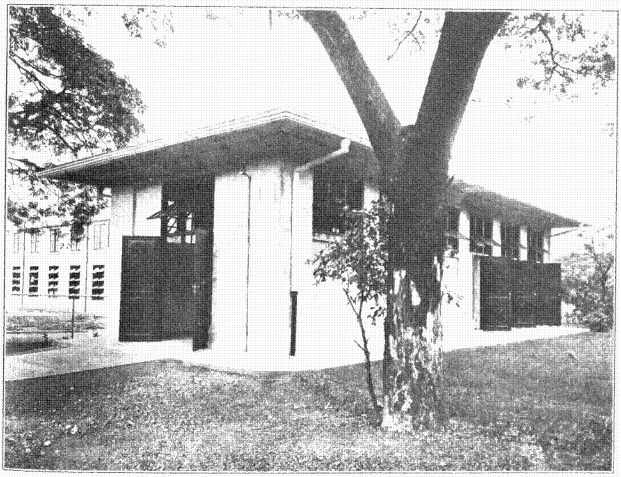

Fig. 2. Serum-animal bleeding building, Bureau of Science.

PLATE II.

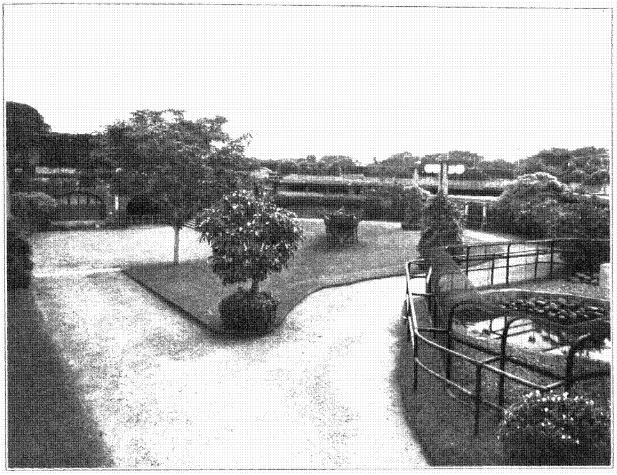

Fig. 1. Bureau of Science Aquarium.

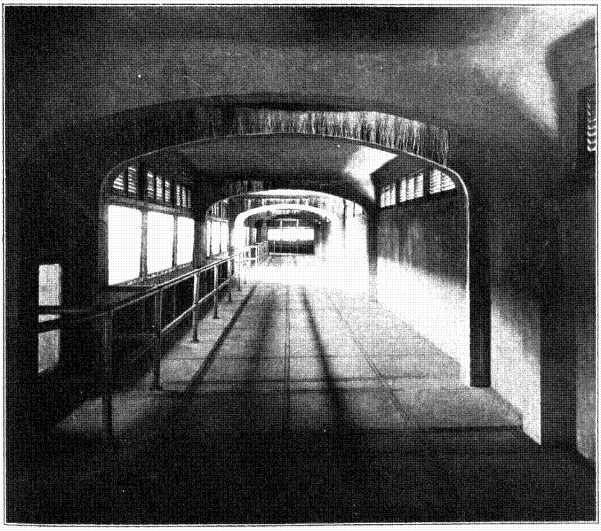

Fig. 2. Aquarium, showing main corridor.

PLATE III.

PLATE IV. LIBRARY, SHOWING A CORNER OF THE READING ROOM AND A PORTION OF THE STACKS.

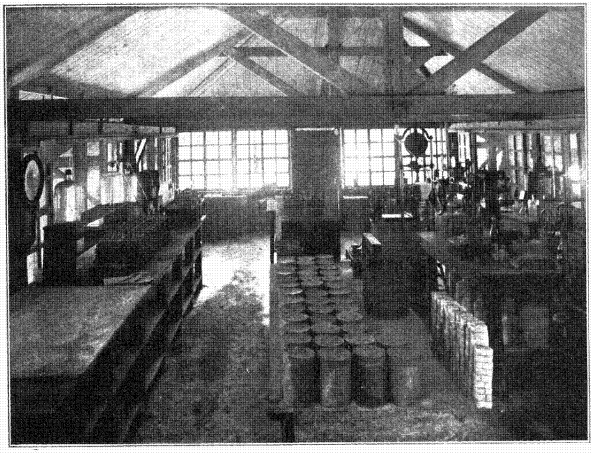

Fig. 1. Bureau of Science cement-testing laboratory.

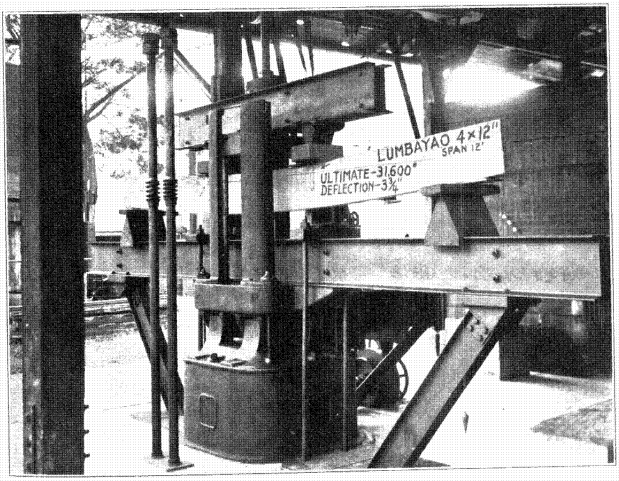

Fig. 2. Testing machine equipped for timber testing.

PLATE V.

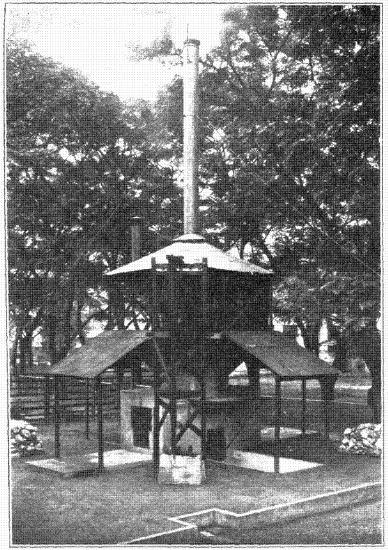

Fig. 1. New lime kiln.

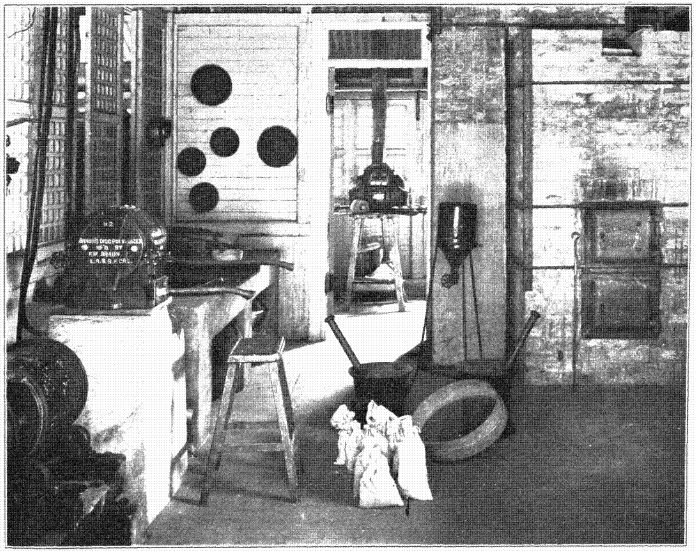

Fig. 2. Assay house.

PLATE VI.

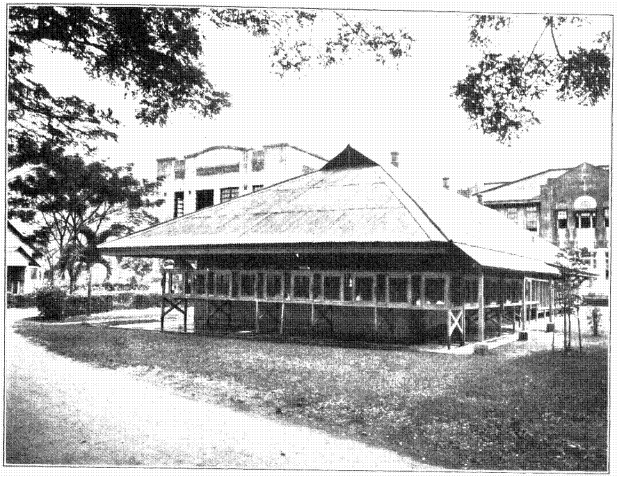

Fig. 1. Small-animal house, showing breeding cages.

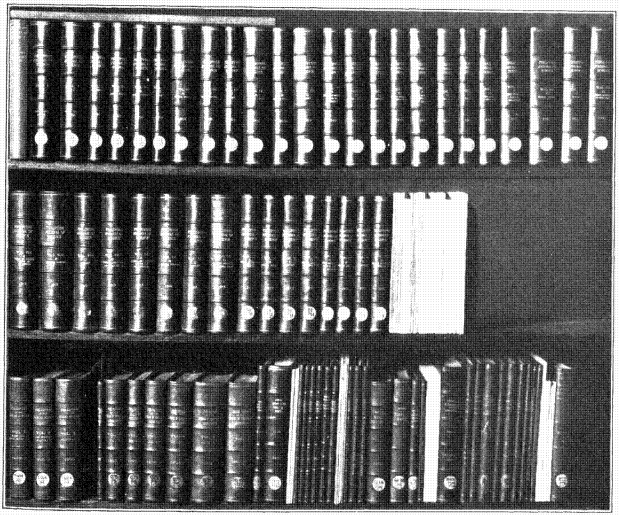

Fig. 2. Publications of the Bureau of Science.

PLATE VII.

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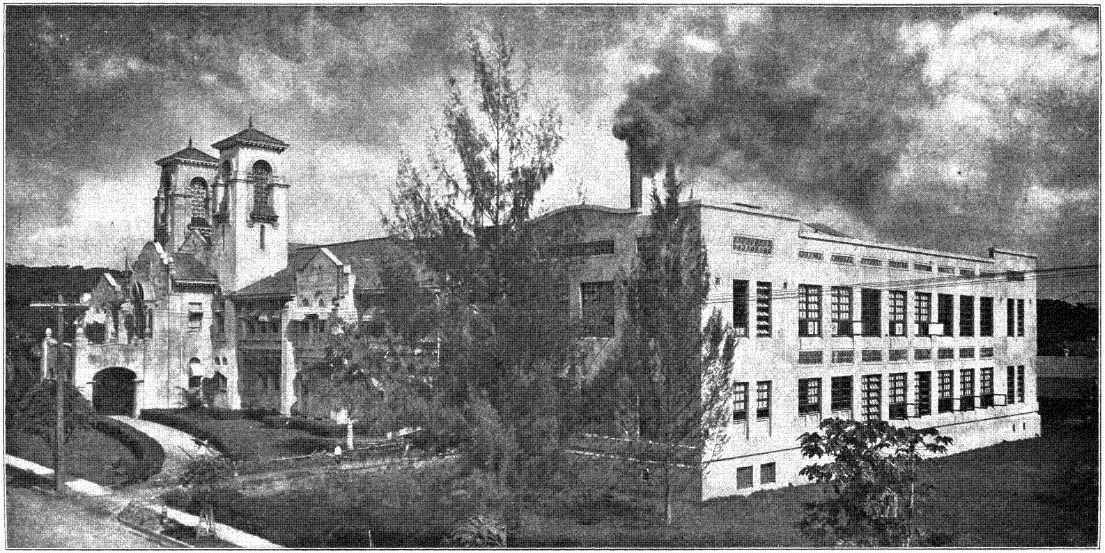

THE MAIN BUILDING OF THE PHILIPPINE BUREAU OF SCIENCE.